THE ENGINEERING AND MINING JOURNAL.

HENRY W. ROY, DEL. COLLINS & SHUGG, SC.

VOL. XI.—NO. 24.—THIRD SERIES.] NEW YORK, TUESDAY, JUNE 13, 1871. [SINGLE COPIES 10 CENTS.

The San Diego and Gila Southern Pacific and Atlantic Railroad.

By Col. THS. S. SEDGWICK, Chief Eng. and Ag't S. D. and G. R. R.

THE San Diego and Gila Railroad supplies the California section of the 32d parallel railroad line from the Mississippi river to the Pacific ocean, and is projected to establish intercommunication between the valley of the Colorado river (and its branches) and the Pacific ocean.

The western terminus is at the bay and harbor of San Diego, a safe and commodious roadstead; and the eastern terminus is at Fort Yuma, on the Colorado, and at the mouth of the Gila river, which runs directly westward across the territory of Arizona for 350 miles, with several branches leading north and south, and drains a geographical area 400 miles long, east and west, and 200 miles wide, north and south.

The bay of San Diego is 450 miles—45 hours south from San Francisco, and 2,780 miles—278 hours north from Panama, and is in the same latitude with the principal ports of China, Japan, and eastern Asia, and north of the Sandwich islands.

San Diego is within ten or twelve miles, northwardly, of the Pacific end of the United States and Mexican boundary line, which leads directly to the mouth of the Gila river, with a right line distance of 148.7 miles, the boundary line thus forming a directrix between the termini of the railroad.

Between the bay of San Diego and the Colorado river there are two grand physical geographical features—the Sierra Nevada mountains, and the Colorado desert.

The Sierra Nevada mountains rise contiguously from the Pacific coast to an elevation of some four thousand feet, in a distance of fifty miles, and slope down to the Colorado desert, eastward, in about twenty miles further, to an elevation only a few hundred feet above the sea. The western slope of the mountains is diversified by a system of valleys, ravines, and cañons, connecting and rising like terraced plateaus one above another, while the eastern slope descends almost precipitately to the desert. The desert extends from the eastern foot of the mountains to the Colorado river, a distance of eighty miles, and is a flat, sandy, sterile plateau basin, with its depression scarcely 150 feet above the sea. Its only redeeming feature is the so-called New River, a drainage depression into which the overflow of the Colorado river finds its way, from a point some twenty miles south of Fort Yuma, discharging an immense volume of water into a yet lower basin of the desert some fifty miles north of the boundary. The New River valley is flooded to a width of some ten miles [and often more] annually, and fertilizes the valley to the extent that good grass is found sufficient to graze herds of cattle, and to enable Indians to raise indifferent crops of corn, squashes, beans, and melons.

A low range of sand hills, with Pilot Knob range of hills surmounting them, cuts the desert off from the Colorado river, and forms its eastern rim, being some ten or twelve miles in extent east and west. Their southern end just reaches to the boundary line. This range is usually spoken of as a part of the desert. The peculiar topographical features of the approaches and crossings of the Colorado river cannot be described except by maps; and the bay of San Diego is best studied from the United States Coast Survey Chart. Two routes have been surveyed for the railroad. The first in 1855, by C. H. Pool, C. E., following the San Diego river to its head, and reached the summit of the mountains at Warner's Pass [which is 45 north of the boundary line], at an elevation of 3,630 feet, and 64 miles from San Diego. The descent to the desert was made in 46 miles, to an elevation of 445 feet, by a very crooked drainage valley—San Felipe and Vallecita.

The line, bearing southeastwardly, would approach the boundary line at New River, near the middle of the desert, and thence lie near the boundary to Fort Yuma. This route is about 230 miles long, increasing the air-line distance by 45 per cent. Two subordinate summits were found on the mountain section, increasing the elevation to be overcome by 873 feet. The summit grades on the western slope vary from 96 feet per mile to 452¼ feet per mile, averaging 158½ feet per mile for a distance of 14¼ miles. The descent to the desert has natural grades of 175 feet per mile for three miles, 263 feet per mile for two miles, and 125 feet per mile for five miles. A more direct line was surveyed in 1869, under the auspices of the Memphis, El Paso Railroad Company, of Texas, by Col. THOMAS S. SEDGWICK, Civil Engineer.

This route leaves the bay by the Otay valley, and follows it to its head at Riley's summit, to an elevation of 1,500 feet at 33¼ miles from New Town, descends to the San Ysidro cañon, in four miles, 660 feet, and thence rises continuously to the summit of the mountains, at an elevation of 3,855 feet, in 30½ miles; thence to the desert by a continuous descent in some 37 miles to an elevation of 500 feet; thence across the desert to Fort Yuma, a distance of 80 miles, (by estimation). This route will be about 185 miles long. If this line were extended to the sea by Otay valley, it would be only 180 miles long, an increase of only 31 miles—or 21 per cent. over the boundary line distance.

This line is remarkable as to general direction between its termini. A chain of valleys was found leading directly eastward from the bay to the head of Carizo cañon (in which the line was laid for nearly eight miles) which, running nearly north, makes the only noticeable break in the general good direction of the line. On the mountain section, the line approaches to within one mile of the boundary in Ticate valley, and at the leaving of Carizo Cañon is 15 miles north of the boundary; indicating that the line may be laid in a belt of 15 miles in width (adjoining the boundary) which cannot be said of any known mountain line of equal length in the United States. The alignment is generally favorable to a first class road.

The gradients rising to Riley's summit will not exceed 90 feet per mile; descending to the San Ysidro valley, a gradient of 100 feet per mile will obtain; and rising therefrom a gradient as high as 105, or, probably, 107 feet per mile for six miles. Thence to the summit of the mountains, twenty-three miles, the gradients will vary—being 80, 90, and 100 feet per mile in sections; while from the Walker's Pass summit down to the Carizo cañon, a direct line of 10½ miles will give a gradient of 110 feet per mile; while a more circuitous line, making the distance fifteen miles, will give gradients of 90 feet per mile. Down the Carizo cañon, and to the desert, the gradients do not exceed 90 feet per mile, as surveyed, while the desert portion is nearly level; and the Pilot Knob hills can be crossed or turned with light gradients.

The general character of the work indicates a great cost of graduation on the mountain section, while the desert section is far below the average of even prairie roads.

Viaducts are indicated to a notable extent. That at San Ysidro crossing will be from 2,000 to 2,500 feet long, and 150 feet high; while the bridge at the Colorado river should be a clear span of 400 feet between bluff banks of granite.

The only tunnel *actually necessary* to be made is in getting out from the Carizo cañon to the desert, by boring through its rim, and will be less than 1,000 feet long; but more detailed surveys made show that two or three others might be adopted with good economy, depending upon the character of the road to be built.

The line will terminate at the best wharfage site on the bay of San Diego, on lands now owned by the company, and is adapted to economical and efficient extension to all desirable points on the bay.

This route is, at the least, thirty miles shorter than the Warner Pass route, is no more expensive per mile, and has more favorable gradients.

Good depot buildings and wharfs will be needed at San Diego, and buildings at Fort Yuma, but few station buildings on the line.

Water stations can be established on the desert, with wells twenty to thirty feet deep, and on the mountains by springs. A natural supply of fuel cannot be obtained near the route, and would need to be supplied at considerable expense.

The following approximate estimate of the cost of grading, masonry (very little), and bridging (almost entirely viaducts), is based on the hurried survey of the Trial Line, the preliminary location of seventeen miles, surveys made at Fort Yuma, and personal examinations.

The road is estimated to cost $22,500 per mile for graduation only; graduation and permanent way, $35,000 per mile; and, with wharfs, depots, shops, and water stations, and sidings, $36,625 per mile, a total of $6,775,500.

The mountain section of the road, 83 miles in length, equals a cost of $37,410 per mile for graduation, and permanent way added, $49,910 per mile, a heavy average. The desert section of 85 miles averages but $8,940 per mile for graduation, and $21,440 with permanent way.

This estimate is based upon an economical adaptation of the roadway to the natural surface, and fairly represents the amount for which the road *can* be built.

The charter of the company provides for an issue of $4,000,000 of capital stock, and the same amount of first mortgage bonds. The company has 8,500 acres of land available as assets, from which from $1,000,000 to $2,000,000 could be realized within five or six years.

The establishment of this road would control the important trade of Arizona and New Mexico, not only with California, but with New York, *via* Panama Railroad route, and steamships which now touch at San Diego, *en route* from Panama to San Francisco, and would be an indispensable link in the 32d parallel railroad line.

Composite Ships.

THE idea of employing iron frames and wooden planking in the construction of vessels has been tried for some time in England, and offers advantages over the use of wood or iron alone. By the employment of iron and wood together, it was intended that the peculiar disadvantages of the iron ship, namely, the tendency of the bottom to foul, should be avoided by applying copper sheathing, and, at the same time, the great structural strength of the iron retained. The composite plan also facilitates the division of the hull, by water-tight bulkheads, in compartments, thus adding immensely to the safety of the vessel. A recent writer on the subject, in the *Mechanics' Magazine*, says: "An iron ship is locally weak but structurally strong, while the converse is the case with a wood-built ship. An iron ship can be built with any desired number of water-tight compartments, whereby, at the cost of some inconvenience in internal arrangements, a largely-increased degree of safety for crew, ship and cargo can be attained. They are also less costly than wooden ships, and they are, in addition, more durable. The points of advantage which are by some considered inherent, so to speak, in a timber-built ship, are too well known to need recapitulation here. There is, of course, less general strength of hull in wooden than in iron ships, but then the former possess the important advantage of having their bottoms sheathed with metal—an advantage of no trifling nature. In fact, the chief objection to iron ships is the rapid fouling of their bottoms. This difficulty once effectually overcome, wooden ships would soon become curiosities of naval architecture. When the composite principle of ship construction first came into fashion, it was generally believed that they would, as the system became more perfected, displace alike ships built entirely of iron and those built entirely of wood. *Prima facie*, the system appeared to combine in itself all the advantages, and some others in addition, belonging to both iron and wooden ships, and varied and ingenious were the methods of combination and construction adopted. It was contended in favor of the composite ship that her frame work of iron permitted of her being built in compartments, if thought necessary, while her wooden bottom could be sheathed with metal. The same facilities exist in composite as in iron ships for the construction of these bulkheads, and it is only necessary for any person, however unacquainted with the art of shipbuilding, to reflect upon the numerous known instances of ships sinking after collisions, to recognize the importance of supplying every composite ship with this undoubted means of safety. It is, in fact, a calamity of very frequent occurrence, and at the present time, when so much is being said, though little, we fear, done—with the view to increased safety and comfort on board our merchant and passenger ships—we cannot do wrong in urging this point upon the attention of all who are engaged in the designing of ships for our mercantile navy. There have been several instances of ships provided with these forward or collision bulkheads coming end on in violent collision, and stillremaining afloat and getting safely into port."

The galvanic action which took place when other than copper bolts were employed to fasten the copper sheathing and the wooden planking to the iron frames, has necessitated the abandonment, to a great extent, of the composite principle. The cost of copper bolts is excessive, and those of galvanized iron are not suited to the purpose. A really seaworthy, well-built ship is, however, only produced at great expense, whether it be constructed of wood, iron, or on the composite plan, and the additional expense of copper bolts would add proportionally less to the expense than to the durability, safety, and sailing qualities of the ship.

The apparent cheapness and strength of iron vessels ruined the shipbuilding interests of this country. Iron ships can be built more cheaply in England than here. American shipbuilding must be based upon the superiority and cheapness of the native timber for years to come. Our ship-yards are to a great extent idle, because it is supposed that iron is superior to wood as a shipbuilding material; but let some Yankee find a cheap and reliable substitute for copper bolts, and we venture to predict that the composite shipbuilders of this country will, ere long, be able to compete successfully with the finest ship-yards of the Clyde or Tyne.

Railroads in Ohio.

OHIO has $205,464,846 invested in railroads. The net earnings for the year ending June 30, 1870, were $15,875,480. During the same year there were killed 4 passengers, 40 employés, and 76 other persons; injured, 14 passengers, 150 employés, and 40 other persons. The total number of miles of track, excluding double tracks and sidings, is (within a fraction of a mile of) 4,387 miles.

The East River Bridge.

ALL of our readers who take an interest either in the science of engineering or in the future welfare of our American metropolis, will be pleased to learn from the report of Chief Engineer ROEBLING, of the East River Bridge, that the work is progressing satisfactorily. The annual meeting of the stockholders of the company was held on Monday, June 5. We have only room for a portion of the report in our present issue. The remainder will appear in our following numbers.

Engineer's Report.

HON. HENRY C. MURPHY, PRESIDENT OF THE NEW YORK BRIDGE COMPANY:

SIR—I have the honor to present the following report of operations on the East River Bridge during the past year:

At the date of the last annual report, made June 5, 1870, the first foundation stone had been laid on the Brooklyn caisson, which was still afloat at the time, rising and falling with the tide. During the year that has elapsed, the foundation of the Brooklyn tower has been successfully completed, notwithstanding numerous drawbacks, the caisson being sunk to a depth of forty-five feet below high water. The tower masonry is now being carried up, and has reached a height of twenty-five feet above high tide.

The first material was brought up from the caisson by dredges, July 5. By December 18, it rested upon seventy-two brick piers, which had been built for its reception within the air-chamber. The filling up of the air-chamber required two months and a half, being finally closed March the 11th, nearly one month of which time was consumed in repairing the damages to the caisson caused by the fire of December 2, 1870. The laying of masonry practically ceased in the middle of December, a rigorous winter forbidding its resumption until the middle of March.

Inasmuch as the Brooklyn caisson is by far the largest structure of its kind ever sunk, although not the deepest, and since the bulk of the material encountered was next to solid rock in difficulty of removal, it may be of general as well as professional interest to enter into a more detailed account of the operations.

EXCAVATION OF MATERIAL.

While the caisson was still rising and falling with the tide, the hours of work inside the air-chamber were confined to low water. Three courses of masonry were required to weigh it down permanently against the buoyant effect of the inflated air-chamber. The force of workmen inside was gradually increased, their principal occupation being the removal of sharp-pointed projecting boulders, which threatened to damage the supporting frames and edges of the caisson as the latter settled down on them with a crushing force at low water.

Although the preliminary dredging had arrived at a uniform level of 18 feet below high water, it was found that there were enough boulders overlooked to reduce this level to 16½ feet. Several weeks were spent in removing them and levelling off the ground under the shoes to the 18 feet level, before the excavating machinery was ready to operate. In the pits under the water-shafts were several large boulders below the water level, upon which the lower edge of the water-shafts rested. These were a source of considerable anxiety until removed by the tedious operation of clipping them to pieces with long steel bars.

The material now became sufficiently exposed to enable us to arrive at the conclusion that it was of a very formidable nature, and could only be removed by slow, tedious, and persistent efforts. This had indeed been the expectation, from our previous experience in the dredging and blasting under water. But the work being under water, and therefore out of sight, did not impress us so much at the time, as now when we were face to face with it.

NATURE OF MATERIAL.

In the two middle chambers of the caisson the ground was composed of trap boulders, large and small, packed together so closely as to touch, the space between being filled by a natural concrete, composed of decomposed fragments of green serpentine rock. The boulders were coated with this natural cement, which adhered so strongly as to defy the action of steel wedges. A steel-pointed pick had no effect whatever. It was only by using a steel-pointed crowbar, and driving it in the crevices with heavy sledges, that any of this material could be piled up and removed. In chambers Nos. 1 and 2, adjoining the Fulton ferry-slips, the boulders were equally as large and as numerous, but the cementing material was clay and gravel, not as hard as the serpentine concrete. In chambers Nos. 5 and 6, however, this hard ridge rapidly fell away, giving place to several feet of mud, underlain by a stratum of unctuous blue clay, and continuing soft in the north corner of No. 6 chamber for a depth of 40 feet, as had been indicated by previous soundings. It was evident, therefore, in order to have a uniform foundation over the entire area of the caisson, it would be necessary to go down fully 40 feet, and this depth was extended to 45 feet, so as to have the timber entirely below the iron bed. The area of the caisson—17,000 square feet—is so large that no uniform stratum over the whole surface would be likely to be found anywhere within this drift formation at any moderate depth below the water level. No better foundation could have been wished for than that found in chambers Nos. 3 and 4, provided it had extended all over. Nine-tenths of the boulders were trap, transported hither during the drift period from the Palisades of the Hudson. Owing to their hardness they had resisted the wear of time the longest. They occurred of all sizes, from one cubic foot up to two hundred and fifty. Boulders of quartz and gneiss rock occurred more rarely. Two large boulders of red sandstone were also found. The softer varieties of rocks had all been worn down to pebbles. A collection made of the various specimens encountered during the descent of the caisson presents a complete series of the rocks found for a hundred miles to the north and north-east of Brooklyn.

LOWERING THE CAISSON.

The adoption of a regular system for lowering the caisson uniformly was a matter of much experiment at the beginning. No amount of pressure could force the bearing surfaces of it through the ground without crushing the cast-iron shoe at the cutting edge or smashing the bearing frames. A few days' experience demonstrated that fact. On the contrary, it became a matter of primary importance to dislodge all boulders in advance before the shoe or the frames came to a bearing upon them.

All this work had to be done under water, because there was usually along the shoe a trench filled with water communicating with the water outside, and this trench was connected with cross-trenches under the frames, which, in time, supplied the large pools around the water-shafts.

The finding of these boulders in advance was a laborious, disagreeable, never-ending task. Its performance fell entirely upon the engineering staff in the caisson, Col. PAINE and Mr. COLLINGWOOD, and the principal foremen, Messrs. YOUNG and CLARK. The perimeter of the shoe or cutting edge measures about 540 feet; adding to this the five frames, of 102 feet each, gives a total length of 1050 lineal feet of bearing surface, every inch of which had to be carefully probed under water twice a day with a steel sounding-bar, and the proper conclusions drawn as to the best means of moving the rocks, hard-pan, and other material found. Each shifting gang of laborers had to be informed anew whenever their turn of work came on. Being under water, this beside became a matter of memory and not of mere eyesight. Moreover, a settling of the caisson of six inches or a foot would bring to light an entirely fresh crop of boulders in new positions, and very often half without and half within the caisson.

The shoe being of necessity unsupported, it was left for the frames to support so much of the weight of the caisson as was not balanced by the air-pressure.

The first attempt in the operation of lowering was to leave small pillars of earth under the frames, about three feet square, and from six to eight feet apart, the intervening earth being taken away, and forming part of the trench. These pillars were to be then uniformly undermined, and the caisson lowered in that manner. It was soon found that the pillars usually concealed the head of a large boulder, which required their premature removal. Again, the water would wash them down, and still oftener the laborers in adjacent chambers not working in unison would undermine them and destroy their effect.

The plan next adopted worked very well, and was pursued to the end. It consisted in supporting the frames every eight feet on two wooden blocks twelve inches square and two feet long, one above the other, with four stout oak wedges interposed between the blocks and bottom of the frame. A continuous trench, two feet deep and four feet wide, was thus maintained under the frames, giving ample working room for the removal of boulders. Whenever the shoe had been cleared out for six inches in advance, these wedges were then loosened with sledge-hammers, one by one and frame by frame, until the caisson slowly settled. Then either new blocks were put in of a smaller size alongside, or, as was usually the case, they were allowed to crush. Very often a sudden descent of the caisson would crush half the bearing blocks until brought up by the shoe. The operation was analogous to the splitting out of blocks and wedges during the launch of a ship. The bottoms of the frames were originally two feet wide. This width was found too great to allow of the easy removal of rocks from underneath. They were therefore cut to a width of one foot. The lower ends of the frames were likewise cut loose from the side of the caisson to allow more easy access to the point of junction. This reduction of bearing surface added materially to the risk in case of accident.

REMOVAL OF BOULDERS AND EARTH.

Boulders occurring inside of a chamber were usually left undisturbed until the caisson had sunk sufficiently to enable us to attack them above the water level. They were then split into manageable blocks by plug and feather. Boulders under the frames presented more difficulty. The ground in which they were imbedded was cut away with steel bars as much as possible; they were then drilled under water, and a lewis inserted. The appliances for pulling them out of their beds were various. Those first in use consisted of double sets of block and tackle, aided by winches and crowbars, with a gang of 30 or 40 men hauling at the ropes. All this force was frequently found ineffective. The strain required being usually from two to three times the weight of the stone. The cause of this lay in the air-pressure, which amounted not only to the 15 pounds of atmospheric pressure, but the caisson pressure in addition, the whole being effective by reason of the water-tight clay in which the stone was imbedded. As soon as the boulder was loosened in its bed to a slight extent it soon followed. These hauling arrangements were replaced after a time by DUDGEON'S hydraulic pulling-jacks, two of ten tons and one of fifteen tons capacity. This proved to be a very effective instrument. They were usually attached to heavy screw bolts let into the roof of the caisson, and formed part of a chain leading to the stone. Many boulders, however, resisted the united efforts of all three jacks. The removal of the hard earth could be effected at the beginning only by the use of steel-pointed crowbars driven in with sledge-hammers. Under water the blow of a pick has but little effect. The long-handled, round-pointed shovel answered best for lifting the material out of water into wheelbarrows.

After the caisson had been lowered about two feet it became possible to build dams around the trenches under the frames and bail out the water. This enabled us to see the work at hand, and materially lightened the labor attending it. These dams were shifted from trench to trench, care being taken always to leave an open trench leading to the water shaft.

The removal of the water from the trenches was accomplished partly by hand-bailing, then by air syphon pumps, and steam syphon pumps, and finally by the compressed air itself, throwing it entirely outside of the caisson through pipes introduced through the timber and masonry.

To work the air syphon a complete system of 1½ inch pipes was placed in the caisson with suitable connections. Through this pipe air was introduced under a pressure of sixty pounds, one of the main air pumps being set apart for that purpose. The pump was constructed on the principle of a Giffard injector, and as the duty required was simply to lift the water from three to four feet it was expected to work well, but it never did. Steam was then introduced in place of extra compressed air through the same pipes. This answered the purpose admirably, draining the trenches in a short time. It afforded an ocular demonstration of the operation of a Giffard injector, since the caisson simply corresponds to the interior of a huge boiler, and steam, under the same tension as the caisson pressure, produced the desired result. One circumstance, however, led to its early abandonment. When the pump had worked a few minutes, the temperature would rise to a hundred degrees, driving the men from that particular chamber. Recourse was then had to a simple flexible suction hose, communicating with a pipe leading out of the caisson. The end of this hose was held in the water, so that about three-fourths of it was submerged. The compressed air rushing through the remainder of the opening kept the whole column of water in motion at a rapid rate. This mode is, of course, attended with a slight loss of compressed air, but it proved far simpler to raise the water forty feet out of the caisson than four feet inside the caisson. Soft mud and fine sand passed out readily with the water.

BOULDERS UNDER THE EDGE.

The occurrence of large boulders under the shoe proved to be the most serious obstacle to a rapid sinking of the caisson. As long as the water from without still had free communication with the air chamber, they had to be attacked under water, the most tedious part of the operation being the removal of the earth in which they were imbedded. When the stones extended more than two or three feet outside of the caisson no attempt was made to haul them in, but they were slowly chipped to pieces, until enough had been removed to enable the edge of the caisson to clear them. As soon as the dredges were at work, the excavated material was dumped around the outside of the caisson with a view of stopping the ready passage of water under the shoe. This was effected after a time. Then, by building a clay dam around the boulder on the inside and filling up the adjoining space with bags, it became possible to dig a comparatively dry pit underneath, into which it was tumbled, provided it was not too large. Several boulders occurred which delayed all settling for three or four days at a time. In order to gain time, a special force of some thirty men was then organized, who worked only at boulders from 11 o'clock at night until 6 A. M., when the regular gangs came to work.

It may truly be said that the result of the first month's work was not very encouraging. We had a material to deal with which is difficult to remove, even under favorable circumstances, on top of the ground. The rate of descent had not averaged six inches per week, and the boulders were increasing instead of diminishing in numbers. To look forward to a rate of lowering of even one foot per week seemed hopeless. The work inside was rendered still more disagreeable by the frequent "blows" caused by the rushing out of the compressed air under the shoe. This would continue for several minutes, until a returning wave of inflowing water from some other part of the caisson would check it, leaving, however, a foot of water all over the ground for some time, until the air pressure drove it out and the occurrence repeated itself. The trenches were usually flooded thereby and had to be pumped or bailed out incessantly. These flows were caused by change of the water level outside, due partly to passing steamboats, but principally to constant changes in the tide. The thick fog which accompanied them was always an indication that they were transpiring in some part of the caisson. On the other hand, we were daily gaining in experience. The workmen became more accustomed to the novel situation and more practiced in the particular kind of work to be done, and the heaping up of a bank of earth around the outside led us to hope that when the caisson had sunk a few feet lower the conditions of air pressure and the general regimen of the caisson would become more equable, and, what was of more importance, the free access of water from without would probably be materially curtailed. These expectations were more than realized. In a short time water became as scarce as it was plenty before.

BLASTING.

When the caisson had arrived at a depth of 25 feet below the water level, the boulders became so large and numerous as to compel us at last to resort to blasting. The idea of using powder had been entertained all along, yet our imaginary fears, supported by plausible reasoning, had prevented the attempt thus far. It was supposed that the effect of the explosion would produce a violent concussion in that dense atmosphere, rupturing the ear-drums of the men. Again, the effect upon the doors and valves of the air-locks might be such as to endanger their safety.

The principal apprehensions were, however, in the direction of the water shafts. Here were two columns of water seven feet square and ultimately forty-five feet high held in a critical balance by the pressure inside, the margin of safety being an immersion of less than two feet on part of the lower edge of the shaft in the pool surrounding it. The sudden explosion might rapidly depress the level of the pool and allow the air to escape underneath, which would be fatal both to the caisson as well

as the men inside. Again, as regards blasting under the shoe and partly outside of it, it was feared that the explosion might cause a vent outward, followed by a rush of air. The result, however, justified none of these apprehensions. First, a trial was made by firing a pistol with successively heavier charges, then small charges were fired off by a fuse, and soon blasting became an established system. The good effects were at once apparent in the lowering of the caisson twelve to eighteen inches per week in place of six inches. As many as twenty blasts were fired in one watch, the men merely stepping into an adjacent chamber to escape the flying fragments. The hard crystalline trap split more easily than the tough gneiss rock or rotten quartz boulder. The trap invariably broke into three equally sized pieces. Great care had to be exercised in guarding against setting fire to the yellow pine roof through the flash and the burning fuse. The gas pipe was broken several times, but the flame was extinguished before damage was done. In blasting under the shoe there was danger of injuring it, but nothing serious resulted. In fact, the shoe was already so badly injured as to amount to but little. The armor-plates were bent and crushed and partly torn off by the jagged points of rocks, the inner casting was cracked, and in many places the whole shoe was forced in; yet no air escaped, because the clay was tight outside.

One convenient way of disposing of boulders under the shoe, was to drill a hole through them, plant the charge at the bottom, and shoot them bodily into the caisson, where they are broken up at leisure. Boulders were found fourteen feet long and five feet in diameter, containing 300 feet and more. The powder smoke was a decided nuisance. It would fill the chambers for half an hour or more with a thick cloud, obscuring all the lights. The use of fine rifle powder ameliorated it somewhat. A sprinkling jet of water to throw it down mechanically was of little avail. The sulphur smell was not disagreeable, simply because the sense of smell is almost entirely lost in compressed air. This is a wise provision of nature, because foul odors certainly have their home in a caisson. The use of powder has proved so efficient that no difficulty is expected in leveling off the irregular surface of gneiss rock upon which the New York caisson will rest.

In order to expedite the laborious task of hand drilling, a small Burleigh drill was procured, mounted on a tripod, and capable of drilling at any angle. It was operated by compressed air of sixty pounds pressure, and worked very well. The trouble, however, of placing it in position and moving it from chamber to chamber more than counterbalanced its other advantages. As the caisson descended it left a perpendicular wall around it, the soil showing but little sign of caving in. The side moreover having an inward slope of one in ten, there was constantly an open cavity between the caisson and this perpendicular face of earth. This opening in some places was ten feet high and wide enough when a large boulder had been removed from under the shoe to allow a man to go entirely out of the caisson. Such cases were rather dangerous, since on two occasions the air had a chance to rush out above through crevices caused by slipping of earth. Such escape would then be followed by cartloads of clay and water, pouring in underneath the shoe.

THE WATER SHAFTS AND BUCKETS.

All the material in the caisson was taken out through the water shafts by means of MORRIS & CUMMINGS' "Grapwell bucket," an instrument which is analogous to the human hand in its action. It is lowered down the shaft by means of two ropes in an *open position;* arrived at the bottom it closes over the material, filling itself at the same time. It is then drawn up and emptied into a car run under for the purpose. For a cut and description I would refer to "Engineering" p. 50, vol. 7. Each bucket has a capacity of 1½ yards, a lift being accomplished every four minutes. The estimated efficiency, making all due allowances, was 800 yards per day. In regular harbor dredging one bucket alone will raise 1,200 yards per day. The total quantity of earth removed from the caisson was over 20,000 yards. Our buckets therefore should have removed the material quite comfortably in one month's time. In place of one month five were required, and these were five months of incessant toil and worry, everlasting breaking down and repairing, and constant study where to improve if possible. We had in fact a material which would not be dredged. The Osgood dredge, which was used for leveling off before the caisson was floated in, could accomplish about ten yards a day, when not aided by submarine blasting, and the MORRIS & CUMMINGS' dredge fished all day without bringing up a handful. The first disappointment lay in the fact that the buckets would not make their own hole under the watershafts. In other parts of the caisson the material could be properly broken up and prepared for the dredges, but the space under the shafts was inaccessible, being under water and out of sight.

When this became evident, there was but one course left to overcome it. This consisted in bolting a wrought iron cap on top of the shaft, and allowing the compressed air to rush into the upper shaft, forcing the water column down into the caisson until the shaft was empty. The pool below was then pumped out. As fast as the compressed air was rushed into the shaft, a quantity of stone was gradually piled up on top of the cap, to prevent it from being blown off. A large pit, with regular sloping sides, from six to eight feet in depth, was then dug out under the shaft, all boulders being lifted out and removed. This pit was dug in the dry, the surface river water being kept back by a temporary dam built around the excavation. The dirt, as it was dug out, was wheeled over to the other shaft. When the pit was complete, it was filled with water, and the air above being gradually allowed to escape, the water would rise in the shaft until the column of balance was re-established. The stone and caps were then removed. This operation was performed quite frequently. Sometimes the shaft would run for three or four weeks without blowing out, then again only one week; but in no case could we pass below the point where it had been dug out. From one to two days were always lost in the operation. During this time, the other shaft did all the work. There were, in fact, so many repairs to the buckets, and so many other drawbacks, that most of the time only one shaft was running. The action of the bucket when it dropped on the material in the bottom of the shaft was that of puddling it into a compact hard pan, harder even than the original soil. To avoid this it was necessary for four men to be constantly stirring the pool to keep the stuff alive, and even then the bottom kept rising. A mixture of stone and clay was sure to fill up the hole in a few hours. The stone, moreover, was apt to become so firmly imbedded in the clay that the teeth of the bucket could not get a firm hold; it therefore became a necessity at an early day to feed all the stones by themselves, and the clay by itself. The best time for feeding stone was when the shaft had been freshly dug out, and they were allowed to accumulate until then. The feeding of stone required much judgment. The bucket could easily lift out any stone it could catch hold of, even up to one or two yards in size, provided the stone was shoved into the right position. Boulders could only be put in from two sides of the shaft, and one stone had to be out of the way before it became safe to put in another. The shaft being rectangular, served as a guide to the bucket, compelling it to come down in the same position each time; this shape was a great advantage, in one respect, but a disadvantage in another, because the square shaft is not as well adapted to withstand a bursting pressure during the operation of capping, without a dangerous change of form, which had to be met by external bracing. Whenever the hole under the shaft was pretty well filled up, the water in the pool was allowed to sink within six inches of the lower edge, and attempts were made to cut down the puddled material with steel bars and sledges. A powerful stream of water from a hose was found useful in cutting it away. Often, when a stone got into a wrong position, men would dive under the shaft, to loosen it. When the lungs are filled with compressed air, a person can remain under water from three to four minutes with ease.

The buckets were provided with heavy teeth, seven inches long, riveted fast to steel-cutting edges 6×1. Many patterns of teeth were made before the most advantageous form was arrived at. A tooth which answers well for scooping up mud, will not last a day for grappling stones. A supply of five buckets was required to keep two in working order. The buckets very rarely became directly jammed in the shafts, except when the latter had been freshly dug out, and the hole below was deep; the buckets were then apt to catch under the edge, causing vexatious delays at times; and unless soon removed, they would then be imbedded in a deposit of clay settling down from the water in the shaft. This had to be removed by a hose, and constant bailing. When the shaft was forty-five feet high, the water in it held seven feet of clay in suspension, and the columns of water, in place of being forty-five feet high, corresponding to a pressure of twenty pounds per square inch, would have a height of only thirty feet, showing that the mixture weighed some ninety pounds per cubic foot in place of sixty-three pounds. When the shaft was idle for a short time, this mixture would settle at the bottom, and outside of it; at the same time the lightened water-column would rise, requiring a fresh supply below. Constant attention was required, not to let the water-supply get too low. The dredges themselves were a frightful source of water-waste. When they closed tight, which was seldom the case, they would usually bring up two-thirds water and one-third mud, the water being allowed to drain through the openings made in the bucket; but the smallest stone coming between the jaws, or any distortion of the bucket, caused by dropping it down on stones, making the teeth interfere, would prevent their perfect closing, and produced a considerable washing out of the material, as the bucket was drawn up through the water. This was the principal disadvantage attending their use; and yet, with all our drawbacks, our daily experience confirmed us in the assurance that we had selected the only instrument capable of disposing of all the material on hand, no matter how large or ill-shaped, or badly-placed the boulder, no matter how tenacious the clay and hardpan, nor how flowing the occasional veins of quicksand. There was, indeed, one period when we were almost tempted to throw the buckets overboard, and another method was devised to take out the material. This consisted in connecting with the pit under the water-shaft a wide and deep trench leading into the chamber. In the bottom of this was a track, with a car on it, arranged with ropes for hauling it in and out from under the shaft. On this car was an open box, lowered down from above; when the car was hauled to one side, the box would be filled, then hauled back and hoisted, the hoisting-ropes remaining attached to it all the time. This whole operation would have to take place under water, and out of sight. The plan never was carried out. It might, perhaps, have failed from the covering of the track by sediment. Much water was consumed, it might be said wasted, in washing the material from the sides of the bucket after it was raised, and in washing it out of the dumping-cars, its adhesiveness easily overcoming its gravity.

DUMPING CARS.

Two kinds of dumping cars were used. One style being provided with a turn-table for dumping the load at any point. The other, and preferable kind, dumped on rockers and required less attendance. The cars were hauled back and forth by steam power. Part of the dirt was used to fill a vacant slip to the rear of the caisson. The bulk of the stone was saved and used subsequently for filling up the air chamber. The remainder of the material was dumped directly into the river and re-dredged by an Osgood dredge, this plan being found cheaper and more expeditious than direct dumping into boats. The cars several times fell into the shafts but were easily picked out by the dredges.

MANAGEMENT OF AIR PRESSURE.

Air was supplied from six double air pumps located three hundred feet from the caisson, a ten inch cast iron main leading therefrom; two rubber hose of six inches diameter introduced it directly into the caisson. When any lengthening out of the shafts had to be done, the air entered only by one hose, but even the six inch hose was more than ample in size. At the beginning, the air pressure was governed entirely by the tides and regulated itself according to their height. The tightness of the caisson was quite satisfactory, and it was soon found that during the falling of the tide it was practically unnecessary to run the pumps at all, the loss of head counterbalancing the leakage. But with a rising tide the pumps had to run at full speed. A declining pressure was always attended by thick fogs which lasted until the tide changed, then, the caisson would remain clear for the next six hours. These fogs were both disagreeable and detrimental to the work by the darkness they caused. They could at times be partly overcome by pumping in a large excess of air, but not always. The fog would occasionally be confined to particular chambers while others would be clear. A slight blowing off under the shoe always caused a fog in that neighborhood. The air space was so large, 170,000 cubic feet, that there was considerable latitude for variations in different parts of the caisson. Every change in the air-pressure produced a rise or fall of the column in the water shaft. As the tide fell, the water filled up the pool under the shaft, and, running over it, would endanger the safety of the dam surrounding it. As the tide rose, the supply in the pool was gradually exhausted and there was danger of the air blowing out underneath unless supplied artificially.

As soon as the caisson had fairly entered into the water-tight and air-tight stratum of clay, the tides no longer had any effect upon the air-pressure whatever. A fixed pressure was maintained according to the calculated head of water. The clay proved so tight that the pressure could easily be raised from 4 to 5 pounds higher than called for by the head of water.

This satisfactory state continued until fresh water springs were encountered. Then there was an end to regularity of air pumping. Sometimes three pumps were sufficient, then again all six pumps running at their maximum speed could not maintain a pressure within four or five pounds of the standard, and as the pumps were overtaxed they broke down and the pressure ran down still further. A judicious banking up of the shoe below with clay afforded considerable relief, but only partial, since it had to be removed again for lowering the caisson. We thus found ourselves in the same predicament with most caisson-sinkers, not from leakage, however, but from want of water. It had been supposed that a pumping capacity of 400 cubic feet per minute, would prove sufficient, but it did not. There was one critical period when the pressure ran down to 11 pounds in place of 19 where it should have stood. On the other hand when the caisson had reached its depth and the shoe was properly banked up, four pumps were ample to keep up a pressure of 20 to 22 pounds. In any event three were needed to supply the necessary fresh air for 120 men and the numerous candles and gas lights, and to prevent a rise in temperature. The thermometer stood uniformly at 78 degrees day and night, winter and summer, whether the temperature outside was 90 degrees or zero.

RELATION OF UPWARD PRESSURE OF AIR TO DOWNWARD PRESSURE OF CAISSON.

In the original design for the caisson, it was the intention to make the air-chamber one vast, unbroken space, without dividing or supporting frames of any kind, reliance being placed upon the solid timber platform of fifteen feet thickness to transfer all strains equally from the shoe inward. To diminish the work above, the masonry was to be built inside of a wooden coffer-dam placed on top of the caisson. This programme was quite feasible theoretically, provided the air-pressure could be maintained at the proper standard without possibility of failure, and provided the caisson was sunk through a soft, uniformly-yielding material. The shoe and sides of the caisson were made strong enough to resist the overweight occurring at each low tide. The requirements of launching, however, made it necessary to introduce five heavy-trussed frames to serve as launching frames; they divided the caisson into six chambers, each frame being also well-braced from the sides. These frames were allowed to remain in, large openings being cut in them for passage to and fro. Subsequent events proved the necessity not only of these frames, but of double the additional support. Very little attention was paid to the matter of supports at first; any irregular bearing below was easily distributed by the roof, even to the extent of having entire frames unsupported at times. The wooden blocking on which the caisson was supported, proved sufficiently elastic to yield without crushing to any extent.

As the caisson sank deeper, much of the dirt coming out was dumped on top of it, filling up all spaces occupied by masonry. This was only the beginning of the overweight to be carried ultimately. Again, at very low tides, the overweight caused by them was equal to the weight of a volume of water 168×102×7 feet, amounting to 3700 tons alone. This overweight kept slowly increasing until one Sunday morning, about 6 A. M., the south water-shaft blew out every particle of compressed air, leaving the caisson in an instant. To say that this occurrence was an accident would certainly be wrong, because not one accident in a hundred deserves the name. In this case, it was simply the legitimate result of carelessness brought about by an over-confidence, in supposing that matters would take care of themselves. The immediate cause of the blowing out lay in the washing away of the dam around the pool under the shaft. These dams washed away frequently at subsequent periods, but we had had our experience and our lesson, and

were prepared for it. There was, unfortunately, no man in the caisson at the time, so that this experience was lost. Eye-witnesses outside state that a dense column of water, fog, mud, and stones were thrown up five hundred feet into the air, accompanied by a terrific roar, and a shower of falling fragments, covering the houses for squares around. This column was seen a mile off. The noise was so frightful that the whole neighborhood stampeded, and a rush was made up Fulton street. Even the toll-collectors at the ferry abandoned their tills. There were three men on the caisson at the time, including the watchman. He reports that the current of air rushing toward the blowing water-shaft was so strong as to knock him down; while down, he was hit on the back by a stone, and further than that he does not remember. One of the other men jumped into the river, and the third buried himself in a coal-pile. It was all over in a minute. Both doors of the air-lock fell open. The dry bottom was visible through the air and water-shaft; not a particle of water had entered under the shoe into the air-chamber, and for the first and only time the caisson could dispense with artificial illumination. As soon as possible a stream of water was passed into the shaft from above, the locks were closed, and in the course of an hour the pressure was restored to fifteen pounds, corresponding to a head of thirty-one feet.

The first entry into the caisson was made with considerable misgivings, but none of our fears were realized. The total settling that took place amounted to ten inches in all. Every block under the frames and posts was absolutely crushed, the ground being too compact to yield; none of the frames, however, were injured or out of line. The brunt of the blow was, of course, taken by the shoe and sides of the caisson. One sharp boulder in No. 2 chamber had cut the armor-plate, crushed through the shoe-casting, and buried itself a foot deep into the heavy oak sill, at the same time forcing in the sides some six inches. In a number of places the sides were forced in to that amount, but in no instance were they forced outward. The marvel is that the air-tightness was not impaired in the least. The nine courses of timber forming the sides of the air-chamber were permanently compressed to the extent of two inches, as was shown by protruding bolt-heads and the shearing off of a number of diagonal bolts. The lower sills of the frames were also torn where they came upon boulders. The weight of the caisson at the time was 17,675 tons. The air blew out so suddenly that this weight must have acted with considerable impact in falling through the space of ten inches. The bearing surface at the time was as follows: The four edges of the caisson, 550 feet long and seven inches wide, amounting to 322 square feet; the five frames, each 100 feet long and one foot wide, resting on twelve blocks one foot wide, amounting to sixty square feet, and giving a total of 382 square feet to meet the above pressure. This at the rate of forty-six tons per square foot. But more than one-half of the shoe was undermined to a depth of one foot or more, which reduced the practical bearing surface by nearly one-half. At the commencement of the shock there was therefore a pressure of eighty tons per square foot, no allowance being made for impact, which may have doubled this rate. The caisson had settled ten inches. The shoe had buried itself so as to present a width of twelve inches, and through the crushing of the blocks the frames were in many places resting bodily on the ground. The settling had, therefore, stopped when a bearing surface of 775 square feet had been reached, giving a pressure of twenty-three tons per square foot. The ultimate pressure on the base of the caisson due to the weight of the tower and superstructure will be only five tons per square foot; hence the margin of safety against crushing is ample. All the above extreme rates of transverse crushing are within the limits of good yellow pine. The fact that the majority of the blocks did crush, is attributable mainly to their irregular bearing and to their shortness; a block of four feet in length will bear a much larger pressure upon one square foot of its surface than a block two feet in length; the same is true in regard to relative breadth. Yellow pine is essentially a hard wood, and before yielding to compression it will split out sideways away from the heart. In the roof of the caisson no effects whatever were produced by the pressure of posts. The timbers are bolted so close laterally that no yielding sideways can take place. Subsequent examinations showed that the roof of the air chamber had assumed a permanent average depression of 4½ inches, being least in the end chamber, and greatest near the water shafts, where there was the least support by frames, and where these openings had cut the timber through from top to bottom. This deflection never increased any. The amount is comparatively small when we consider that the transverse span is 102 feet between bearings, that the whole caisson and timber above it is a composite structure, bolted together, and that the joints in the timber are butt joints. That amount of deflection is scarcely sufficient to bring all the bolts to a full bearing. As the caisson proceeded in its downward course, the disproportion between the dead weight above and the air pressure from below became greater and greater. For instance, on the 15th of November, the escape of air under the shoe was so strong that no more than ten pounds of air pressure could be maintained. The over pressure entailed thereby was 12,240 tons. This was received by a bearing surface of 280 square feet, causing a pressure of 44 tons per square foot. In order to meet this constantly increasing overweight, a large number of additional shores were introduced into the caisson. They rested upon a block and wedges, and supported a cap spiked against the roof. The presence of these shores added considerably to the labor of lowering the caisson, and diminished the available working space otherwise. They gave, however, a positive assurance against any possible crushing weight from above, and could, moreover, be easily removed when a boulder was taken out, which could not be done with the permanent frames. The downward movement of the caisson was usually so impulsive that the blocks under the posts were allowed to crush and were subsequently dug out. In fact, their crushing was the only indication we had that any portion of the caisson was bearing particularly hard. The noise made by splitting of blocks and posts was rather ominous, and inclined to make the reflecting mind nervous, in view of the impending mass of 30,000 tons overhead. No satisfactory estimate could ever be made of side friction. There must have been some, but of a very irregular character. At times an outside boulder would apparently hold one end of the caisson until a bolt-head or part of the timber gave way. The batter on the outside, being one foot in ten, was calculated to relieve the caisson from side friction. The workmen, however, never dug out far enough behind the shoe, thus causing great friction for several feet up the sides, and pressing in the sides to as much as nine inches in some places. The side friction probably never exceeded 3,000 tons. The larger the base of a caisson, the smaller is the percentage of side friction available to counteract downward pressure, whereas in a narrow caisson penetrating a uniform sand it is often sufficient to counterbalance the whole weight.

BRICK PIERS.

When the caisson had arrived within three feet of its proposed resting place, it was considered advisable while the air chamber was being filled with concrete, to erect for its support seventy-two brick piers, systematically located and averaging twenty square feet of base. Their ultimate capacity was just sufficient to support the whole weight above in case the air should blow out. It was felt that where openings exist like the water shafts, there exists also a possibility of the air blowing out, no matter what precautions are taken or how much care is used. The precaution was therefore safe even if not needed. Subsequent events showed the necessity of it. The piers were completed in three weeks, requiring 250,000 bricks in their construction. The inevitable strike attended the employment of the large force of brick layers, men new to the place and circumstances. It was easily overcome, however, and caused no delay. Shortly after the caisson had come to a bearing on the piers and the concreting had been in process a fortnight, one of the supply shafts blew out. The tension of the air was reduced in a few minutes from eighteen to four pounds and the piers had to bear the brunt of the weight.

BLOWING OUT OF SUPPLY SHAFT.

A few words will suffice to explain the mode of operating the supply shaft. It consists of a tube forty-five feet long and twenty-one inches diameter, inside, with a door at the bottom opening into the air-chamber, and a long door on top, through which the material is thrown in. When the upper door is open, the lower one is held shut by the air-pressure, assisted by two iron clamps worked by levers. As soon as a certain quantity of material has been thrown in, the upper door is pulled up, and the compressed air being thus allowed to enter firmly closes it. When the shaft is filled with compressed air, a signal is given to the attendant below, who removes the lugs, the door falls and the contents of the shaft drop into the air-chamber. The operation is very simple and rapid, perfectly safe with the most ordinary precaution. Two of these shafts were found ample to furnish all the material required for filling up the caisson. They had worked well for five weeks, but danger always steps in when, through daily use and familiarity, the attendants become careless and reckless. It had occurred at times that a charge of building stones or brick would become jammed, and only part of a load would drop out. To ascertain this fact, a string with a weight was let down from above each time, so as to avoid putting in a double charge. Upon this occasion a charge had jammed, the men dumped in another, without measuring the depth either before or after, and then gave the signal to the man below, without shutting the upper door, or letting on the compressed air. The second charge happened to loosen the first, and the two together overcame the pressure against the lower door, when the lugs were turned. As soon as this happened, the air commenced to rush out of the caisson with a great noise, carrying up stone and gravel with it. The men above ran away, leaving those below to their fate. Any one with the least presence of mind could have closed the upper door by simply pulling at the rope. I happened to be in the caisson at the time. The noise was so deafening that no word could be heard. The setting free of watery vapor from the rarifying air produced a dark, impenetrable cloud of mist, and extinguished the lights. No man knew where he was going; all ran against pillars or posts, or fell over each other in the darkness. The water rose to our knees, and we supposed, of course, that the river had broken in. It was afterward ascertained that it was due to the sudden discharge of the columns of water contained in the water-shafts. I was in a remote part of the caisson at the time; half a minute elapsed before I realized what was occurring, and had groped my way out to the supply-shaft, where the air was blowing out. Here I joined several firemen in scraping away the heaps of gravel and large stones lying under the shaft, which prevented the lower door from being closed. The size of this heap proved the fact of the double charge. From two to three minutes elapsed before we succeeded in closing the lower doors. Of course everything was all over then, and the pressure, which had run down from seventeen to four pounds, was fully restored in the course of fifteen minutes. A clear and pure atmosphere accompanied it. The effect upon the human system and the ears was slight, no more than is experienced in passing out of the airlock. Careful examination was made to see what effect the weight of thirty thousand tons had upon the brick pillars and other supports. Although the pressure on the piers was twelve tons per square foot, these showed no signs of yielding. In the neighborhood of the water-shafts and supply-shafts, where there were no brick piers or other supports, a slight local depression took place in the roof. The occurrence demonstrated the fact that the pillars were strong enough to bear the whole load, and also proved the necessity of their erection. A few small springs of brackish and fresh water started beneath the concrete under the shoe, but were easily repressed. There was no increase of leakage. It was rather remarkable to notice that there was no rush of air in the immediate vicinity of the supply-shaft, not even for several feet up the shaft; the action was one of free expansion in all directions.

The question naturally arises, what would have been the result if water had entered the caisson as rapidly as the air escaped. The experience here showed that the confusion, the darkness and other obstacles were sufficient to prevent the majority of the men from making their escape by the airlocks, no matter how ample the facilities. If the water entered as rapidly as the air escaped, there would then be the same pressure of air during the whole time of escape. Now, it so happens that the supply-shafts project two feet below the roof into the air-chamber; as soon, therefore, as the water reaches the bottom of the shaft, it will instantly rise in it, forming a column of balance, and checking the further escape of air. The remaining two feet would form a breathing space sufficient for the men to live, and even if the rush of water were to reduce this space to one foot, there would be enough left to save all hands who retained sufficient presence of mind.

(To be continued.)

MINING SUMMARY.

Nevada.

RAILROAD DISTRICT.

The Elko *Independent* of May 27th contains the following article on this district: On Friday of last week, in company with several gentlemen of the medical fraternity of Elko, we paid a visit to Railroad District, with a view of examining the mines and the natural resources of that vicinity, and of making a note of the developments and the working of the same. We were much pleased with the trip, and were enabled to glean the following facts: Railroad District is situated about twenty-two miles nearly due south of Elko, and is about the same distance from Carlin in a southeast direction. The road from Elko to Railroad is a good one, and is now in splendid condition. The business point of the district is Bullion City, which lies at the base of Railroad mountain, in a beautiful valley, or cove, formed by grassy, rolling hills, which are covered with a luxuriant growth of wild flowers at the present time. At this place, about a year ago, the Palisade Smelting Works were erected, and after the projectors had successfully smelted a large amount of ore, the property passed into the hands of C. E. GILLETT, Division Superintendent of the Central Pacific Railroad at Carlin. The location for the furnace and other buildings properly connected, with a convenient running of the same, is a splendid one, to which belongs a water right and other privileges secured at an early day by right of location and appropriation. The furnace is a substantial one, built of stone and brick upon the most recent improved plan. The engine and other machinery connected therewith is also well adapted for the purpose in view. Preparations are now being made by Mr. GILLETT for starting up the furnace at an early day. A little higher up the ravine, and to the right of the town (two hundred yards), there is now being erected by LOUIS E. LOSCHENKOHL, a first-class furnace, upon the cupola plan, the inside finish being somewhat like the oval shape of an egg. We have every reason to believe that this furnace, when finished and in operation, will prove a success, from the fact of the scientific attainments and practical experience of the parties who are engaged to build and operate it. Water is found in abundance in nearly all of the gulches that make down from Railroad mountain. There is also an inexhaustible supply of timber for building, fuel, mill and coal purposes found in the vicinity, a majority of which is of the nut-pine species, which makes the best charcoal. The mines of the district are found on the northeast side of the main peak, called Bunker Hill, which reaches an altitude of not less than 7,000 feet above the level of the sea. The first mine visited was the Black Warrior, located on the northwest ridge, forming the right hand cañon from the main gulch, owned by FRANES, MCELWAIN & Co. The ledge is about four feet in thickness, with little or no outcroppings, and is favorably located for working. The vein is decomposed, and contains gold, silver, and a small amount of base metals. It is, however, believed that the ore will pay handsomely by mill process, and in fact it is the only mine that can be worked in that way. Upon reaching the main ridge of the mountain connecting the two peaks, Bunker Hill to the south, and Columbia Hill to the north, forming the Railroad mountain, we found and examined a large number of fine ledges, some of which were opened out and exposed to view much good-looking quartz, highly metalliferous. Among others, we mention the Sweepstakes as most prominent, and which has a large per centage of copper; also the Pine Mountain lode, which is similar in its formation to the Sweepstakes. On the west side of the ridge before described, looking towards Pine Valley, are found the Wiscousin Chief, Mountain Boy and Chambersburg lodes—the latter owned by MCELWAIN, GILLETT and HYLES. The Nevada and Silver Peak are also on this slope of the mountain. Copper largely predominates in all of the above-named ledges, except the Black Warrior, and they may properly be classed as lodes containing rebellious ores, and all have nearly the same combinations of base metals. We now come to the northeast slope of Railway mountain, called Bunker Hill, upon which is located a large number of splendid ledges containing fine smelting ores. Amongst the most important lodes here are the Bunker Hill and Bullion mines, upon which there has been sufficient work done to open to full view the size and character of the ledges. Just above is the Shoo Fly, a fine looking ledge, upon which a good deal of work has been performed, but apparently of little practical value. A tunnel of some seventy-eight feet has been run, at which point a rich body of ore is exposed to view. Over fifty tons of bullion have been extracted from this mine. The Extension Bullion is a large and well defined ledge, from which some ore has been excavated. A few hundred feet to the east of this mine is situated the Humboldt ledge, which has uncovered to sight the largest body of ore of any mine in the district; and as far as we are able to judge from the surface appearance of the ore now open, it is undoubtedly a valuable mine. This mine is owned by BRODHEAD & Co. The Last Chance is another fine mine of some nine feet in thickness, and is owned by E. V. ROBBINS, of Elko. From the work already done, and the character of ore taken out, it bids fair to be a first-class mine. Directly below the Last Chance is located the Lincoln lode, belonging to CHARLES A. BROSEMER. This claim extends over six hundred feet, and contains a three-foot ledge of pay ore, averaging not less than $80 per ton. The True mine, in the same neighborhood, is similar to the Humboldt. The vein is well defined, with a happy combination for

easy working. From working prospects $100 per ton have been realized without any particular section of the ore. This mine is under the control of Dr. ALEX. KINKEAD, of Elko. The Red Jacket mine has a well defined ledge of four feet, and is similar in its character of ore to that of the True mine. The Tripoli mine is located in the southeast side of Bunker Hill, and is now being worked. A large quantity of pay ore from it is already sacked and ready for shipment. The hanging wall of this mine is well defined and contains a vein of some six feet of splendid ore. The Tripoli is controlled by A. J. ROULSTONE. We also noticed several splendid looking mines belonging to E. L. RICHIE & Co., and among others the South Fork ledge, of some four feet of well-defined galena ore, which promises to be equal to the best mine in the district. Some splendid ore has been excavated and is now upon the dump. A shaft and tunnel have penetrated the ledge to the depth of eighty feet. The California mine, belonging to the company last mentioned, is a ledge of about five feet of solid ore, and assays about forty per cent of copper, carrying with it considerable silver. The same company owns the Orphan Boy ledge, upon which it has sunk a shaft to the depth of about fifty feet, where the vein is about five feet wide. There are about thirty tons of fair quality of ore taken out. L. E. MORGAN and Mr. PAYTON are the owners of several fine developed ledges, which we should be pleased to notice if time and space would allow, but will allude to them more fully hereafter. All of the above mentioned ledges situated on Bunker Hill, generally run southeast to northwest. The bed-rock, in which these ledges are imbosomed, is slate and sandstone. In the immediate vicinity of the mines are found limestone and magnetic iron ore, in immense quantities; in fact, all of the fluxes and other working materials for an easy, cheap and successful smelting of the ore are found here. At some future time we will again call the attention of our readers to this district, and many mines of merit that we have here omitted shall then be noticed, as well as all new developments and rich strikes that may be made in those which have already been mentioned.

BULL RUN DISTRICT, NEVADA.

A correspondent of the *Scientific Press* writes from this district, May 3d: Everything is looking satisfactorily here now. The Ogden Company have commenced work on their lode, and the McShane Company have also started up. The Johnson mine is looking better than ever. It is situated on what is known as Johnson Hill, at an elevation of 3,778 feet above the sea, and about 300 feet below the summit of the hill on the west side. The vein pitches to the east at an angle of forty-five degrees for some forty feet from the surface, and then changes to a dip of sixty degrees. At the depth mentioned it is wider than at the surface, and shows an abundance of good ore. It has regular walls, and is bounded by slate on one side, and by limestone on the other. The Porter mine has been leased by Mr. MOTT, of Sacramento, who has twelve men at work extracting the ore, and who will, we understand, employ ten more in a few days. The ore will probably work $400 per ton. Mr. MOTT has a pack train, loaded with ore to be worked at Vance's mill, at Mountain City, and will keep this train employed all summer carrying ore from here to Mountain City. It is said that Mr. MOTT has also leased the Revenue mine, and will start in on it in a couple of weeks. Prospectors are coming in daily, and lively times are expected here this summer. Our district has been subjected to many inconveniences, as you know. There is one point, however, which I would now touch on, as it is an undeserved evil under which we have labored. A certain class of men, pretending to be mining experts, have come hither, and, after visiting one or two mines, have gone away without further examination of what we have, and have given unfavorable reports concering the place. One person of this class was here last fall, and, after looking at the Blue Jacket and Found Treasure, returned, saying that he did not wish to see any more. Now, these men did not really see what we have, and are unqualified to form a fair judgment. The decision against the two mines named, is open to much criticism. But let me give a short description of them. The Blue Jacket has a well-defined ledge, with regular walls. A shaft, which is sunk fifty-nine feet on the vein now exhibits better ore below than it does above; and a drift, run in ninety feet from the bottom of the shaft, shows an abundance of rich ore all through the ledge, which is twenty feet wide. Of this ore, fifty tons, worked at Mountain City, yielded $246 per ton; over 200 tons are now on the dump (this could not be removed last fall, for the snow prevented pack trains from getting up to the mine); and thousands of tons are in the mine, of richer quality than that previously shipped. The Found Treasure has been prospected to a depth of 100 feet by shafts and tunnels, with plenty of ore in sight, and forty tons on the dump, which will work over $800 per ton. The ledge is eight feet wide, with good castings in both sides. The great objection to these ledges is that they are high up on the mountain, and therefore inconvenient of access by wagon; still they are excellent properties.

PLACER COUNTY.

The Grass Valley *Union* of May 24th, has the following interesting article on the quartz mines of Auburn:

As the quartz mines around Auburn, Placer county, are attracting much attention, and as they are sure to attract still more attention from capitalists of this country as well as of Europe, we deem it proper to give a sketch of the mining industry of our neighboring county. We make our statements from careful personal observation and inspection, and we made the inspection because we wished to prove the proposition that mining in California, so far from being in a decline, is but commencing. The Auburn district is the most notable instance and witness in favor of our favorite proposition. That district was "played out," as the cant phrase has it, years ago, as a mining district, and had settled down into a semi-agricultural region, with the population now and then scratching on the croppings of the numerous quartz ledges there, to find gold bearing pockets. The district is now a mining one, and mining is the engrossing business of the people of the Auburn neighborhood. A review of the mines there will show why labor, energy and capital, seek the Auburn district as a field for mining operations. The country rock in the Auburn district is much like that of Grass Valley. This insures permanency for the ledges, and the ledges show for themselves in metalliferous character.

ST. PATRICK MINE

is located about three miles, almost due west, from Auburn. This mine is the best developed one in the district, and is so far one of the most successful mines in the State. The total depth of the shaft is 220 feet. From this shaft three levels have been run. The first level is at the depth of eighty feet, and has been run in toward the west, a distance of twenty feet. In this level the ledge is two and a half feet thick. The second level has been opened at a depth of 125 feet. The second level has been run into the east the distance of thirty-three feet, and in this level the ledge is two and a half feet thick. The second level has been run to the west twenty-two feet, and in it the ledge is two feet thick. The third level is at the depth of 200 feet, and has been driven to the east the distance of 100 feet, and has a vein twenty inches thick; and to the west a distance of twenty feet, with a vein two and a half feet thick. The shaft is down twenty feet below the third level, and in the bottom of the shaft the ledge is four feet thick. The mineral bearing qualities of the ledge may be inferred from the fact that out of the excavations and openings we have described, gold to the value of over $50,000 has been excavated. "The ore in sight" may be calculated in this manner:

Depth of shaft	220 feet
Lower level opened	140 "

These numbers multiplied give 30,800; and that multiplied by two feet, which is the average thickness of the ledge, gives 61,600 cubic feet of ledge developed. Dividing this by 14, the number of cubic feet in a ton of quartz, we have 4,400 tons in sight. On the dump there are 200 tons of ore. This gives a total of 4,600 tons in sight. For convenience, and because of the upper and shorter levels having been run, we throw off 100 tons, and call the total of ore in sight at least 4,500. The last crushing of average ores yielded nearly $80 per ton. The next crushing, as good judges of ore inform us, and as we believe, will pay over $100 to the ton. The openings in the mine show a ledge which is remarkably uniform in its mineral bearing qualities. The value of the ore in sight at that rate will be $450,000, or fifty per cent. more than the price of the whole property at the market value of the stock. In every instance the richness of the ore increases with the depth, and the St. Patrick mine, so far, is no exception to the rule. The St. Patrick ledge descends almost perpendicularly for 180 feet, and then takes an angle of about forty-five degrees, pitching south. The ledge is enclosed in hard and smooth walls, and has not yet shown a fault. Two gentlemen of this place, familiar with mines, and who have worked in the Eureka and Idaho mines of Grass Valley, visited the St. Patrick mine with us, and they pronounce the latter a true ledge, and one of extraordinary richness. The hoisting is done with a small "donkey engine," and no pumping is required. The water is easily controlled with tubs. In addition to the St. Patrick ledge, the company own two other ledges, called the "Big Doig," and the "Little Doig," so named from the locator of them. The Little Doig runs nearly east and west parallel to the St. Patrick. The Big Doig runs from the northeast to southwest, crossing the St. Patrick and Little Doig ledges diagonally. Both of the Doig ledges have been very rich on the croppings, when formerly worked, the Big Doig especially being rich. It is said, on good authority, that JAMES DOIG, the locator, took out about $40,000 from the croppings of the two ledges which bear his name. The croppings of the St. Patrick ledge and the Little Doig ledge are distant from each other about 125 feet. The permanent working shaft of the ledge, or ledges, will be near the junction of the Big Doig ledge with the St. Patrick. The croppings of all the ledges can be traced on the surface for a long distance—say more than a mile. The St. Patrick mine is under the charge of Mr. J. W. ROBERTS, Superintendent, with Mr. HARRY MILL, formerly of Grass Valley, and a thorough miner, as foreman. The success of the St. Patrick in the past, and its great prospects for the future, have done much to make Auburn district a mining one.

SHIPLEY MINE

is located about six miles west from Auburn, on Shipley Ravine. The company have commenced work in earnest, and in a systematic manner. The permanent shaft, of a size of fifteen feet by five, is being put down on the ledge, and is now at a depth of about sixty feet. The ledge is a very large one, being from five to six feet in thickness, and stands almost perpendicularly. At present the hoisting is done by a "whipsiderry," but steam machinery will be put on whenever economy demands it. North of this permanent shaft, and distant from it seventy-five feet, is a small shaft 104 feet. The ledge in this deeper shaft is looking very well, or as a mining friend of ours remarked, "she sits like a duck upon the water." North of the main shaft, and distant about 1,000 feet, is an immense outcrop of quartz standing about fifteen feet above the surface of the ground at the highest, and being about ten feet thick and seventy-five feet long. This outcrop is metalliferous to a paying degree, and on one of the highest points of it free gold can be seen. The Shipley company have a ten-stamp mill run by water power. The wheel of this mill is forty feet diameter, and is capable of driving twenty stamps. The ten stamps now used will crush twenty tons of quartz for every twenty-four hours. The power costs the company about $3 per day. Ore from the Shipley mine can be mined and milled at about $4 per ton, while the croppings yield by mill process from $10 to $12 per ton. The ledge improves as the depth increases. The Shipley mine must prove a very valuable property. The company owning it is a San Francisco incorporation.

ST. LOUIS MINE

is situated about a quarter of a mile west from the Shipley mine. The vein runs nearly north and south, and is enclosed in feldspathic granite. The vein is of the average of two feet in thickness. The company are running in a tunnel on the face of the ledge, and this tunnel is now in about 100 feet. When the tunnel is completed to the point designed, backs of 120 feet will be opened. The quartz of the St. Louis is of the laminated, or ribbon kind. The rock shows fine free gold, and occasionally rich specimens of rock bearing free gold are found. This mine is just being developed. The sulphurets assay well, and a ton of them shows, by assay, $150 in silver and $150 in gold. The sulphurets are argentiferous gray copper ore with iron pyrites, with the gold. A San Francisco company own the St. Louis mine. The ledge can be traced on the surface two and a half miles to the little hamlet called Gold Hill.

GREEN MINE

is well known to all who are interested in mines. It has been wonderfully rich, and is now in the same condition. The lowest depth attained in the Green is 125 feet. Of late rock has been taken from a level at sixty-five feet in depth. From this level, within the last thirty days, gold to the value of over $40,000 has been taken. The owners are working miners of the Auburn district.

COX & DENTON

mine is one and a-half miles northwest of Auburn. Work, looking to permanency, is being done at this mine. A shaft is being put down on the ledge, and a tunnel on the surface of the ledge is being driven. The shaft and the tunnel will connect at a depth of over 100 feet for the shaft, and a length of 300 feet for the tunnel. The company have constructed a fine road from the Auburn Ravine turnpike to the mine, and within a few days comfortable buildings, to be used as offices, boarding-houses, and sleeping apartments, will be put up. The Cox & Denton mine have caused buildings to spring up, like Jona's gourd, in a night, and unlike Jona's gourd, they will not wither in a night. The rock from this mine looks well in sulphurets, and tests made from the croppings, years ago, by mill process, prove that the ledge is a paying one. The ledge is well defined, and as far as developed, shows an average of three and a-half feet in thickness. San Francisco and Auburn men own this mine.

Colorado.

THE KROM CONCENTRATOR.

This concentrator effects a separation of metallic and earthy substances in the dry way by means of air, as our readers will remember from an article we published some time since in regard to it. One of these machines is in operation at the Washington mill, Colorado, and Mr. WILLIAM BEMENT, the superintendent, who has improved the machinery lately, has furnished to the Georgetown *Miner* the following returns, from a lot of ore from the Terrible lode, concentrated for Messrs. CROW & CLARK, that show the practical results obtained from dry concentration: "The amount of ore delivered at the Washington mill was 423 tons, which was dried, and it then weighed 407½ tons. Crushing, sampling and assaying of this ore proved that it contained silver to the amount of $54 22 per ton, thus making the total value of the ore $22,094 55. This ore was concentrated from 407½ tons into 178 tons, or very nearly 2.3 tons into one. The results from the concentrated ore were as follows:

Cost of reduction and loss by amalgamation	$7,933 81
" concentration and hauling ore to mill	3,595 50
Loss on 229½ tons of tailings, at $3 91	897 37
Cost of hauling concentrated ore to reduction works	178 00
	$12,604 66

"The value of the crude ore, as shown above, was $22,094 65; the expenses of treatment being $12,604 66; the net returns were $9,489 99."

The *Miner* comments on these results as follows: "Now let us see what the net returns from this ore would have been had it not been first concentrated. The ore, previous to concentration, weighed 407½ tons, and contained $22,094 65 in silver. The reduction works in Georgetown, at which this ore was treated, returns 80 per cent. of the value of the ore, at a cost of $25 per ton. The returns from the treatment of the crude ore would have been as follows:

Cost of reduction	$10,187 50
Loss by amalgamation	4,418 93
Hauling ore to mill at $3 per ton	1,269 00
	$15,875 43

The value of the ore being $22,094 65, the net returns from this method of treatment would have been $6,219 22. A comparison of the two methods of working shows that the above-mentioned 407½ tons of ore from the Terrible lode yielded a net return of $9,489 99, when concentrated previous to being milled; and that the same ore, if it had been treated *without* concentration, would have netted $6,219 22, thus showing an actual and positive gain of $3,270 77 ($8 02 per ton) by the use of concentrating machinery. The magnitude and character of this test of the practical workings of dry concentration is positive proof of the value of the system in use at the Washington mill. The results obtained clearly show that there is merit in the Krom concentrator, and that very many of our ores can be more profitably worked than they now are, by first concentrating them. Mr. BEMENT is now engaged in concentrating Terrible ore for the Terrible Lode Mining Company and for the Clark Mining Company, and in the last fifteen days has crushed and concentrated 180 tons. The mill is full of ore awaiting concentration."

According to the Central City *Register* of May 31, Mr. BEMENT has also concentrated a lot of ore weighing 3,500 pounds—an average of a four feet vein cut by the Monticello tunnel down to 210 pounds—which assayed 112 ounces per ton, the finest size assaying 228 ounces per ton, while the dust assayed only six ounces. The company are now dressing twelve tons of ore daily, and on the average reduce it from five to one. This gives an actual cash value to much of the hitherto worthless ore.

Montana.

A correspondent of the Deer Lodge *Independent* writes from Blackfoot, May 14: One of the oldest, if not the very best, camps in Montana is Blackfoot. The longer one tarries in the neighborhood of Ophir, the more he is convinced of its superior advantages as a placer camp over many others of more recent discovery and wider reputation. Here, no heavy outlay for machinery is required, and no corporations combine to crowd to the wall the single-handed miner. Here water streams (this season, at least,) down every gulch which industry and energy, unaided, has conveyed through artificial channels, crossing and recrossing each other in their serpentine course to the numerous rich-paying bars by which the camp is surrounded. But Blackfoot, like most old rich camps, is not free from the nuisance (nay, the blighting curse,) of the "coming man." His almond-shaped eye peeps out from many a dingy pane, and his sallow skin and disgusting presence meets the eye upon many a sunny slope in the suburbs. Should this evil continue unabated, this, like many other laboring men's camps, must soon be abandoned to the "heathen Chinee" and his Josh. Many new placers are this year being opened, and, from the abundance of water, we may safely predict a larger yield of "ore" than in any previous season.

The same paper has the following items: PEMBERTON & Co. cleaned up on Saturday from their claim near Pioneer City, $2,160, the result of one week's run. Ten pipes will be playing there this week, which will shortly add to the quantity of metallic substance so much prized by miners and people generally.—E. T. ELLERHART, of German gulch, was in Deer Lodge last evening, *en route* to Helena. He informed us that every claim in German gulch was being worked night and day. An abundance of water enables the miners to ground-sluice with good effect. There will be but little money taken out for about two months, because the claim owners are determined to bare as much bed rock as possible during the high stage of water. There is no doubt that more money will be taken out in that camp than ever before in one season.—Breaks and such like on Divide Creek ditch at Silver Bow have put that camp back full one week.—At Rocker the miners are on a strike; claim-holders paying $4 a day in currency, and employés demanding $5.

From the *Montanian* of the 11th we clip the following: The Clipper ledge, in Iron Rod district, has a two-and-a-half foot crevice of quartz that pays $75 per ton.—The Oro Cache ledge pays $50 per ton, and the mill is kept at work on this class of rock.—How's mill in Brown's gulch is turning out thirty-five ounces of silver bullion per ton that is worth from $2 to $4 per ounce.—Captain DAVIS, at Junction, has struck diggings that pay $1 50 per pan.—There is four feet of quartz in the Red Bluff ledge, Hot Springs district, that pays $50 per ton.—Placer mines have been discovered on Polecat creek that prospect from four to ten cents to the pan from the surface down, which has caused a stampede to that locality. They are believed to be extensive.—The miners at Bannack are now all busily engaged in the mines, which gives the town a deserted appearance.

THE COAL TRADE.

BENJAMIN R. WESTERN, COAL EDITOR.

Anthracite Coals.

NEW YORK, June 9, 1871.

WHOLESALE.—The trade has never before been in such a stagnant condition as at present. There are several reasons why this is the case, the most prominent among which is that the method of transacting the coal trade has changed—that is, there seems to be no longer a necessity for retail dealers to stock up early in the season, except for those far distant in the country, whose only means of transportation are by canal. Therefore buyers only come into the market and make purchases as the demand requires, and in other respects trade like other merchants. Years ago, when transportation from the coal regions was entirely by canal, it was the custom for dealers to stock up early in the season, for fear of being deprived of a supply by a break in the canal, or some other trouble incident to the fall season. Now, all this is changed; new railroad routes have been opened up one after another, until a perfect network covers the surface of Pennsylvania, and the supply of coal can be furnished at one time as well as at another. Our dealers, however, take a long time to comprehend these improvements; and yet think the trade should be done in the old-fashioned way. They are surprised that the low figures asked for coal now (low in comparison to those quoted two months since,) do not immediately cause a rush in the market of dealers eager to take all the coal offered. They seem to think that their old fogy notions can be forced upon the present progressive generation of coal dealers. They might as soon think of assembling each branch of the coal trade, the Schuylkill, the Lehigh, and the Lackawanna, in their respective offices, and making prices for the entire year, as they used to do years ago. Did they do the latter, they would be laughed at and hooted out of the trade. Then the method of buying has changed; retail dealers are no longer fearful of not getting a supply, unless, indeed, a strike occurs. This is the only reason that we can give for the present dull trade. All other branches of business are depressed—it is between seasons, as it were. The spring trade is over, and it is too early for the fall trade to begin. There also seems to be a feeling among retailers that prices must yet go lower. They are educated in the immense facilities that we have for producing coal, and argue that, with so many at work, and such admirable facilities for bringing it be market, the public has a right to demand cheap coal. We ourselves share in the feeling that possesses the retail trade, and have not yet advised dealers to buy. We know that many rely on our judgment as to the right time to buy, as well as to the kinds of coal to buy, and we do not choose to loose the faith of our readers. Some dealers are under the impression that the following circulars of the Philadelphia and Reading Railroad Company have had the effect of producing the present stagnation, though they do not appear to us to be sufficient cause:

Circular No. 18.

PHILADELPHIA AND READING R. R. Co.,
OFFICE, 227 South Fourth street,
PHILADELPHIA, May 15, 1871.

If any contracts are made with manufacturers or consumers for Lump, Steamboat, Broken or Chestnut Coal, in quantities of 1000 tons, at a fixed price to be named in the contract, and the coal so sold is shipped from Richmond, consigned for consumption to any point whatever, and if such contracts are filed in the office of this company on or before the first of July next, there will be paid upon all coal shipped from Richmond before December 1st next, to fill such contracts, such a sum as drawback as will reduce the tolls from Schuylkill Haven upon such coal to one-third of the price at which the said coal is sold on board at Richmond; provided that the said rate of tolls shall not be less than $1 20 per ton from Schuylkill Haven. It being understood, however, that the shipper shall, for the time being, be entitled to the benefit of any current drawback whenever such current drawback is more than the above contract rate. The Philadelphia and Reading Railroad Company reserves the right, upon the presentation of any such contract, to decide whether the purchaser is a manufacturer or consumer.

FRANKLIN B. GOWEN, President.

Circular No, 19.

PHILADELPHIA AND READING R. R. Co.,
OFFICE SCHUYLKILL CANAL,
PHILADELPHIA, May 22, 1871.

If any contracts are made with manufacturers or consumers for Lump, Steamboat, Broken or Chestnut Coal, in quantities of 2000 tons and over, at a fixed price to be named in the contract, and the coal so sold is shipped from Schuylkill Haven, via the Schuylkill Canal, before November 1st, consigned for consumption to New York City, or points between New Haven, on Long Island Sound, and Poughkeepsie, on the Hudson river, and if such contracts are filed, in writing, in the office of this company, on or before the first of July next, such a drawback will be paid as will reduce the charges for tolls and transportation upon such coal to one-half of the price at which the coal is sold at the wharf, at its destination, exclusive of the charge for towing from New York City; provided that the minimum rates of freight and tolls shall not be less than $2 50 per ton from Schuylkill Haven. If the coal is sold to be delivered at places other than New York, between New Haven and Poughkeepsie, the following amounts will be deducted from the price at which the coal is sold before the division is made:

ON THE HUDSON RIVER.

Manhattanville	8	cents per ton.
Spuyten Duyvel	9	"
Yonkers	10	"
Hastings	11	"
Piermont	13	"
Dobbs' Ferry	13	"
Nyack	15	"
Tarrytown	15	"
Sing Sing	16	"
Croton Landing	17	"
Haverstraw	17	"
Verplanck's	17	"
Peekskill	18	"
West Point	20	"
Newburgh	18	"
Poughkeepsie	20	"
ON LONG ISLAND SOUND.		
Norwalk	40	"
Southport	40	"
Bridgeport	40	"
New Haven	40	"
Westport	45	"
Milford	45	"
Branford	50	"
Harlem	$18	per boat.
Mott Haven	18	"
Port Morris	20	"
West Farms (mouth of creek)	25	"
West Farms	35	"
Westchester	30	"
College Point	25	"
Flushing	30	"
White Stone	30	"
East Chester Town Dock	60	"
New Rochelle	50	"
Glen Cove	50	"
Mamaroneck	70	"
Port Chester	70	"
Greenwich	80	"
Stamford	80	"
Darien	80	"

The Philadelphia and Reading Railroad Company reserves the right, upon the presentation of any such contract, to decide whether the purchaser is a manufacturer or consumer.

FRANKLIN B. GOWEN, President.

The trade is well aware that Mr. GOWEN will endeavor to get a market for Schuylkill coal in New York, if there is any possibility of accomplishing it. He has, during the recent suspension, bought up some 40,000 acres of the most valuable coal lands in the Schuylkill district, and he intends to make a market for that kind of coal. He is going forward in the right way to accomplish it. The Schuylkill coal that has been sent to this market on sale during the past five years has been the refuse that Philadelphia would not buy at any price. Schuylkill coals have, therefore, a very poor reputation here. Mr. GOWEN means to correct a bad impression, and is going to put his best coals in the market at low figures and defy competition. Of course the large companies, particularly the Pennsylvania Coal Company and the Delaware and Hudson Canal Company, who have actually controlled the Hudson river and State trade, do not like this encroachment on their domain. But this buyers have nothing to do with; the question with them is, Where can we buy good coal at the lowest rates? So one finds the above-named companies will have to be up and doing, for Mr. GOWEN evidently means business.

The Lehigh operators met in Philadelphia yesterday, and adjourned "*sine die*" without making any propositions to their men, who are at present on a strike. We are informed that they will not meet again until the miners and laborers have some distinct proposition to make to them. We are thus to be deprived of the best coal that comes to our market, indispensable for certain manufacturing purposes—except only what the Lehigh Coal and Navigation Company can supply. This is a mere drop in the bucket.

PRICES.—While business is so dull, quotations are but nominal.

FREIGHTS.—Vessels are in better supply. Freights are, however, scarce and rates lower. We quote: $1 90 to Boston; $1 40 to Providence; $1 10 to New Haven and Bridgeport.

RETAIL.—Trade in this department is very dull. Many families are leaving town without laying in their usual winter supply, as has been the custom heretofore.

Bituminous Coals.

The Cumberland Bituminous coals are in good demand, and prices are firm. We quote $6 50 in schooners and $7 alongside. Our readers need not be afraid to buy Cumberland coal at these rates. They are the lowest we have known for years, and we do not hesitate to advise dealers to buy now. It will be remembered that during the late trouble in the Anthracite regions, Cumberland coal remained steady in price, and, in fact, so fearful were the proprietors of the mines that the public might think that they would take advantage of their position, (which was almost an actual monopoly of the coal trade,) that they reduced their prices some fifty cents per ton. They have received their reward by an increase of custom which will stand by them hereafter.

Anthracite Coal Trade for 1870 and 1871.

The following table exhibits the quantity of Anthracite Coal passing over the following routes of transportation for the week ending June 3, 1871, compared with week ending June 3, 1870.

COMPANIES.	1870. WEEK.	1870. TOTAL.	1871. WEEK.	1871. TOTAL.
*Phila & Reading R.R.	26,394	996,791	109,835	999,448
Schuylkill Canal	1,637	67,382	34,963	186,055
Lehigh Valley R. R.	53,525	1,375,361	25,973	542,885
Lehigh & Sus. R. R.	21,867	386,518	39,239	309,054
Lehigh Canal	20,498	100,901	12,075	36,604
Scranton North	16,418	272,465	14,604	88,468
" South	39,399	753,548	26,868	
Penn. Coal Co., rail	25,720	453,820	16,155	42,665
" " canal	399	4,653	236	236
Del. & Hud. Canal Co.	52,720	445,259	37,236	59,521
" " East	6,164	182,579	6,641	61,092
" " West	2,063	33,970	1213	1,968
South	12,715	68,831	5,092	44,117
Shamokin	6,954	132,888	10,519	256,271
Trevorton	2,048	33,515	....	....
Lykens Valley Coal Co.	1,536	10,375	1,881	31,698
Wyoming South	4,024	55,243	....	....
Wyoming North	....	....	....	....
P. N. Y. C. & R. R. Co.	6,515	127,842	4,479	44,279
Williamstown Col'y	5,600	110,678	....	....
Big Lick Col	1,169	15,642	2,010	47,790
Total	317,325	5,638,461	349,019	2,752,151
1870	.....	2,752,151	317,325	
Decrease	.....	2,886,310		
Increase				31,694

* Less coal transported for Company's use and Bituminous coal.

Bituminous Coal Trade, 1870 and 1871.

The following table exhibits the quantity of Bituminous Coal passing over the following routes of Transportation for the week ending June 3, 1871, compared with week ending June 4, 1870.

COMPANIES.	1870. Week.	1870. Year.	1871. Week.	1871. Year.
B. & O. R. R.	19,064	333,008	29,594	491,217
C. & O. Canal	16,041	158,777	21,814	232,625
H. & B. T. R. R.	6 669	127.402	8,594	158,249
Harrisburg & D.	13,487	330,042	19,107	340,919
L. V. R. R.	.....	6,622	.....	37,725
P. & N.Y.C. & R. Co.	5,856	95.714	6,963	126,578
Cumberl'd Branch	4,070	38,398	1,770	31,623
" Canal.	2,799	32,744	5,314	68,986
Total	67,993	1,122,707	93,156	1487,922
			67,993	1122,707
Increase.			25,163	365,215

Report of Coal Transported over Lehigh Valley Railroad

Report of coal tonnage for the week ending June 3, 1871, and previously this season, compared with same time last year:

WHERE SHIPPED FROM.	WEEK. Tons. Cwt.	TOTAL Tons. Cwt
Total Wyoming	18,867 06	122,927 06
" Hazleton	6 03	222,318 00
" Upper Lehigh		442 06
" Beaver Meadow	22 18	75,400 04
" Mahanoy	12,189 10	205.419 13
" Mauch Chunk	488 15	2,858 06
Total Anthracite	31,574 12	629,365 15
Bituminous Coal from all sources		37,725 00
Total by rail and canal	31,574 12	667,090 15
Same time last year	85,973 13	1,622,647 00
Increase		
Decrease	54,399 01	955,556 05
Forwarded East from Mauch Chunk by rail	25,973 09	542,885 09
Same time last year	63,524 18	1,375,361 00
Increase		
Decrease	37,551 09	832,475 11

RECAPITULATION.

Forwarded East from Mauch Chunk by rail	25,973 09	542,885 09
To N. C. R. R., at Mount Carmel		1,890 17
Forwarded North from L. & B. Junction	4,478 19	44,452 17
To L. & S. R. R. at Packerton for rail	55 01	2,894 10
Delivered at M'h Chunk	5 08	426 16
Delivered on line of road above Mauch Chunk	175 00	4,287 16
Delivered above Mauch Chunk for use of L. V. R.R.	687 18	20,840 02
To L. & S. R. R., at Penn Hav., for railroad		94 10
Do. for canal		7,128 09
At M. Chunk for canal	198 07	4,464 09
Total Anthracite	31,574 12	629,365 15
Bituminous Coal		37,725 00
Total all kinds	31,574 12	667.090 15

Report of Coal Transported over Central R.R. of N. J. (Lehigh and Sus. Div.)

Week ending June 3, 1871-Compared with same time last year.

WHERE SHIPPED FROM	WEEK 1871., tons ct	WEEK 1870. tons ct.	YEAR 1871 tons cwt.	YEAR 1870. tons cwt.
Wyoming Region	44407 11	29951 17	316435 08	452217 09
Upper Lehigh Region		4525 04	4614 06	49019 04
Beaver Meadow Region		4249 00		25648 14
Hazleton Region	95 14	10421 12	1744 12	53370 03
Mahanoy Region				
Trescow Region	182 09		1336 02	
Mauch Chunk Region	5949 13		35292 07	30089 18
Totals	50635 07	49147 13	359422 15	610345 08
Increase				
Decrease	1487 14		250922 13	
DISTRIBUTION.				
Forwarded East of Mch Chunk by Rail	39239 00	21867 02	309054 04	396518 03
Forwarded East of Mch Chunk by Canal	4912 16	21652 09	15011 05	105770 19
Delivered at and above Mauch Chunk	1155 07	1093 19	22720 02	16874 14
Delivered to L. & B. R. R. at Plymouth Bridge	2833 19	3799 17	3029 15	79835 08
L. V. R. R. at Packer'n	2494 05	734 06	9607 09	11346 04
Totals	50635 07	49147 13	359422 15	610345 08
Of the above there was transported on acc'nt of L. C. & N. Co.	8317 17		39911 18	46743 15
W.-B. C. & I. Co.	30778 08	16174 16	262846 06	187435 02
Totals.	39096 05	16174 16	302758 04	234178 17
Increase	22921 03			
Decrease			68579 07	

Lehigh Canal Coal Trade.

Shipped for the week ending June 2, 1871.

	WEEK. Tons. Cwt.	TOTAL. Tons. Cwt.
Total from Mauch Chunk Region,	9137 18	23276 17
" " Beaver Meadow "		728 12
" " Mahanoy "	198 07	1031 01
" " Hazleton "		1246 00
" " Upper Lehigh "		
" " Wyoming "	2729 05	10321 03
Total	12075 10	36603 13
Corresponding week last year	20497 19	100900 13
Increase		
Decrease	8422 09	64297 00

Philadelphia & Reading Railroad and Branches.

COAL TONNAGE

For the Week ending Saturday, June 3, 1871.

BY RAILROAD.—ANTHRACITE.

PASSING OVER MAIN LINE AND LEB. VAL. BRANCH.

	Tons. Cwt
From St. Clair	40,067 10
" Port Carbon	9,186 17
" Pottsville	2,278 11
" Schuylkill Haven	33,179 15
" Pine Grove	6,106 04
" Tamaqua	17,368 17
" Harrisburg	4,918 03
" Dauphin	
Total	113,105 17

FOR SHIPMENT BY CANAL.

Passing Frackville Scales	10,967 15
" Mill Creek "	1,980 06
" Schuylkill Valley Scales	745 09
" Mt. Carbon "	2,161 04
" Cressona "	14,726 10
" Pine Grove "	
" Tamaqua "	1,973 03
Total	32,454 07

SHIPPED WESTWARD VIA NORTHERN CENTRAL RAILROAD.

Passing Locust Gap	2,517 15
" Shamokin	1,943 07
" Herndon	
Total	4,461 02

SHIPPED WEST OR SOUTH FROM PINE GROVE.

Via Schuylkill & Susquehanna R. R.	844 08
" Lebanon & Pine Grove Branch	694 02
Total	1,538 10

CONSUMED ON LATERALS.

From Frackville Scales	454 10
" Mill Creek "	300 16
" Schuylkill Valley Scales	297 02
" Mt. Carbon "	456 11
" Cressona "	159 02
" Pine Grove "	64 13
" Tamaqua "	77 06
Total	1,810 00

LEHIGH AND WYOMING COAL.

Received via Allentown, E. Penn's Br.	10 11
" " Alburtis, "	16 15
" " Oreland, G. & N. Br.	76 15
" " Connecting R. R. "	
" " Willow Street R. R.	42 07
Total	146 08

BITUMINOUS.

From Harrisburg	14,189 05
" Connecting R. R., G. & N. Br.	
" Junction R. R.	167 01
Total	14,356 06

COAL FOR COMPANY'S USE.

Anthracite	2,227 11
Bituminous	377 08
Total	2,604 19

RECAPITULATION

	Total for Week.	Corresponding week last Year.	
Passing over Main Line and Leb. Val. Branch	113.105 17	28,877 12	i 84,228 05
For Shipment by Canal	32,454 07	3,558 18	i 28,895 09
Shipped Westward via Northern Central R. R.	4,461 02	3,268 03	i 1,192,19
Shipped West or South from Pine Grove	1,538 10	248 17	i 1,289 13
Consumed on Laterals	1,810 00	2,577 15	d 767 15
Lehigh and Wyoming Coal	146 08	2,780 16	d 2,634 08
Total Anthracite paying fr'gt	153,516 04	41,312 01	i 112204 03
Bituminous	14,356 06	9,274 15	i 5,081 11
Total of all kinds paying fr'et	167,872 10	50,586 16	i 117285 14
Coal for Company's use	2,604 19	2,645 05	d 40 06
Total Tonnage for Week	170,477 09	53,232 01	i117245 08
Since Dec. 1, 1870	1600170 19	1484674 06	i115496 13
Total to date	1770648 08	1537906 07	i232742 01

SHIPPED BY CANAL

	Total for Week.	Corresponding week last Year.	
From Schuylkill Haven	33,312 10	2,552 00	i30760 10
" Port Clinton	1,651 00	251 00	i 1,400 00
Total Tonnage per Week	34,963 10	2,803 00	i32160 10
Since Dec. 1, 1870	151 091 17	65,134 15	i85957 02
Total to date	186,055 07	67,937 15	i111811712

Philadelphia and Reading R. R.

Amount of coal transported on the Philadelphia and Reading Railroad during the week ending Saturday, June 3, 1871:

	tons. cwt.
From St. Clair	40,067 10
" Port Carbon	9,186 17
" Pottsville	2,278 11
" Schuylkill Haven	33,179 15
" Auburn	7,712 15
" Port Clinton	17,368 17
" Allentown and Alburtis	40 13
" Harrisburgh and Dauphin	19,106 19
Total paying freight	128,941 17
Coal for Company's use	2,604 19
Total for week	131,546 16
Previously this year	1,202,289 11
Total	1,333,836 07
To same time last year	1,326,868 06

Schuylkill Canal.

Report of coal transported over the Schuylkill Canal for the week ending Saturday, June 3, 1871.

	Tons. Cwt.
From Port Carbon	
" Pottsville	
" Schuylkill Haven	33,312 10
" Port Clinton	1,651 00
Total for week	34,963 10
Previously this year	151,091 17
Total	186,055 07
To same time last year	67,581 15

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, June 3, 1871.

	WEEK.	SEASON.
North	46,010 14	74,870 00
South	5,092 03	44,117 03
Total	51,102 17	118,987 03
Corresponding time in 1870:		
North	49 441 01	960,127 15
South	12,715 02	168,831 03
Total	62,156 03	1,128,958 18
Decrease North	3,430 07	885,257 15
Decrease South	7,622 19	124,714 00
Total decrease	11,053 06	1,009,971 15

The following is a statement of Coal transported by the Delaware and Hudson Canal Co., for the week ending June 3, 1871.

	WEEK.	SEASON.
By Del. and Hud. Canal	37.236 00	59,521 00
By Railroad East	6.641 00	61,092 00
" West	1,213 00	1,968 00
South	5,092 00	44,117 00
TOTAL TONS,	50,182 00	166,698 00
For the same period last year.		
By Del. and Hud. Canal	52,720 00	445,259 00
By Railroad East	6.164 00	182,579 00
" West	2,063 00	33,970 00
" South	12,715 00	168,831 00
TOTAL TONS,	73,662 00	830,635 00

Delaware, Lackawanna & Western Rail Road Company.

Coal transported on the Delaware, Lackawanna and Western R. R. for week ending June 3, 1871.

	Week. Tons. Cwt.	Year. Tons. Cwt.
Shipped North	14,603 14	
Shipped South	26,868 2	
Total	41,471 16	88,468 8
For the corresponding time last year:		
Shipped North	16,418 1	.....
Shipped South	39,398 14	.....
Total	55,816 15	1,026,013 12
Increase	.....	.....
Decrease	4,344 19	937,545 4

Pennsylvania Coal Company,

Shipments of Pittston Coal for the week ending June 3, 1871.

	1871. WEEK.	1871. YEAR.	1870. WEEK.	1870. YEAR.
By Railway	16,155 9	42,665 4	25,720 2	453,820 1
" Canal	236 9	236 9	359 10	4,652 11
Total	16,391 18	42,901 13	26,079 12	458,472 12
Decrease 1871, 415,570 19 tons.				

Shamokin Coal Trade.

For week ending June 3, 1871	10,519 00
Same time last year	6,953 16
Increase	3,565 04
Decrease	
Total amount shipped to date	256,270 13
Same time last year	132,887 11
Increase	123,383 02
Decrease	

Huntington and Broad Top R. R. Co.

For week ending June 3, 1871	8,594 tons.
Same time last year	6,669 "
Increase	1,925 "
Decrease	....
Total amount shipped to date	158,249 "
Same time last year	127,402 "
Increase	30,847 "
Decrease	....

Report of Coal forwarded by Pa. & N. Y. R. R. Co., for week ending June 3, 1871.

	ANTHRACITE. Tons.	Cwt.	BITUMINOUS. Tons.	Cwt.
By Rail	4,478	19	6,963	03
Previously this year	39 800	04	119,615	03
Total by Rail	.....		.....	
By Canal	.....		.....	
Previously this year	.....		.....	
Total by Canal	.....		.....	
Total for the year	44,279	03	126,578	06
To the same time last year	127,842	09	95,714	00
Decrease	83,563	06		
Increase			30,864	06

Statement of Coal Transported over Cumberland and Pennsylvania Railroad

During the week ending Saturday June 3, and during the year 1871, compared with the corresponding period of 1870.

WEEK.

	To C. & O. Canal. Tons.	Cwt.	To B. & O. R. R. Co Tons.	Cwt.	Total. Tons.	Cwt.
1871	21,814	09	29,594	02	51,408	11
1870	16,041	02	19,063	17	35,104	19
Increase.	5,773	07	10,530	05	16,303	12
Decrease						

YEAR.

1871	232,625 10	491,216 13	723,842 03
1870	158,776 15	333,008 09	491,785 04
Increase.	73,848 15	158,208 04	232,056 19
Decrease			

Cumberland Branch.

WEEK.

1871	5,313 19	1,769 18	7,083 17
1870	2,799 08	4,070 02	6,869 10
Increase.	2,514 11		214 07
Decrease		2,300 04	

YEAR.

1871	68,986 03	31,623 03	100,609 06
1870	32,743 19	38,398 00	71,141 19
Increase.	36,242 04		29,467 07
Decrease		6,774 17	

Big Lick Colliery Coal Trade.

For week ending June 3, 1871	2,009 11
Same time last year	1,169 03
Increase	840 08
Decrease	
Total amount shipped to date	47,789 19
Same time last year	15,641 15
Inc ease	32,148 04
Decrease	

Lyken's Valley Colliery Coal Trade.

For week ending June 3, 1871	1,881 00
Same time last year	1,536 04
Inc ease	344 16
Decrease	
Total amount shipped to date	31,697 17
Same time last year	10,375 15
Increase	21,322 02
Decrease	

Prices of Coal by the Cargo.

[CORRECTED WEEKLY.]

	AT NEW YORK, May 30. R. A.	W. A.	AT PHILADELPHIA, May 29. R. A.	W. A.
SCHUYLKILL.				
Lump	$—	$—	—	—
Steamer	6 50	—	—	—
Broken	7 50	—	—	— to —
Egg		— to —	—	— to —
Stove		—	—	— to —
Chestnut	—	—	—	— to —
Pea	—	—	—	—
LEHIGH.				
Lump, (along side)	—	—	—	—
Broken	—	—	—	—
Egg	—	—	—	—
Stove	—	—	—	—
Chestnut	—	—	—	—
Pea	—	—	—	—
SPECIAL COALS.*				
Diamond Vein	R. A. 7 50@8 00		—	—
New England	"		—	—
Locust Mountain	W. A.	8 50	—	—
Honey Brook, Le'h	W.A.		—	—
Spring Mountain	"		—	—
Sugar Creek	"	"	—	—
Sugar Loaf	"	"	—	—
Old Comp'y's.	"	"	—	—
Cross Creek	"	"	—	—
Room Run			—	—
Girardville	"	"	—	—
McMichael	"	"	—	—
Shamokin	"	"	7 25	—
Lykens Valley	"	"	7 75	—
Broad Top	"	"	6 25	—
Hill & Harris	"	"	7 25	—
Henry Clay	"	"	—	—
Powelton	"	"	6 25	—

[*Dealers in these coals may be found in our advertising columns.]

Company Coals.

June, 1871.

	L.	Str.	Gra.	Eg.	Sto.	Ches.
Scranton at E. Port	5 00	5 25	5 50	5 75	6 00	5 25
*Pittston at Newburgh	5 50	5 50	5 20	5 80	6 00	5 30
*Lackawana at Rond't	5. 20	5 20	5 50	5 75	6 00	5 20
Wilk'b're at Hoboken	5 00	5 00	5 40	5 75	6 00	5 25
Old Co. Lehigh at Pt. Johnston	6 75	6 00	6 00	6 00	6 50	5 50
Lehigh at E. Port	—	—	—	—	—	—

For freights to different points see "Freights."
* to contractors.

Prices for Coal at Mauch Chunk.

May 1871.

BITUMINOUS COALS.

Kittaning Coal Co.'s Phœnix Vein..f.o.b. at Phila.	$	—
Lemon " " "		—
Cumberland Vein Coal		—
Consolidation Coal Co.'s on board	N. Y.	6 75
Maryland Coal Co. "	"	6 75

Prices at Baltimore—June, 1871.

Wholesale Prices to Trade.

Wilkesbarre, by cargo or car load	$5 25@5 50
Pittston and Plymouth, do	5 25@5 40
Shamokin Red or White Ash, do	5 25@5 40
Lykens Valley Red Ash, do	— —@5 80
Zerba Valley	— —@— —
Treverton	— —@— —
By retail, all kinds per ton of 2240 lbs	7 00@7 50
Georges Creek & Cumberland f. o. b. at Locust Point for cargoes	— —@4 75
Fairmount and Clarksburg gas, f. c. b. at L. Point	6 00@6 50

Prices at Georget'n, D.C., & Alexandria, Va.

June, 1871.

George's Creek and Cumberland f. o. b. for shipping..$4 50 @4 60.

Prices at Havre de Grace, Md.

Wilkesbarre and other White Ash for cargoes	$5 50@5 75
Lykens Valley	6 00@6 25
Shamokin Red or White Ash	5 50@6 00
Trevorton and Zerba Valley	— —@— —

Prices of Gas Coals.

June, 1871.

PROVINCIAL.

Corrected weekly by Louis J. Belloni, Jr., 41-43 Pine st., N. Y.

	Duty, $1 25, gold. Coarse	Slack.
Block House	$1 75	@1 75
Gowrie	1 75	@1 75

Corrected by Bird, Perkins & Job, 86 South street.

	Coarse.	Culm of Coal.
Pictou	$2 25	@1 25
Sydney	2 25	@— 80
Lingan	1 60	@— 80
Little Glace Bay	1 60	@1 00
Caledonia	1 60	@— 80

A discount from the prices of the coarse Coal on purchase of 5000 tons and upwards. Duty $1 25 per ton, gold, on the coarse coal. 25 per cent. ad valorem on the Culm of Coal.

AMERICAN. *Currency.*

Westmoreland	7 10	@7 25
Fairmount Gas Coal Co. of N. Y.	7 50	@— —
Despard Coal Co.	$7 50	@— —
Penn	7 75	@8 00
Newburg Orrel Gas	— —	@— —
West Fairmount Gs Caoal	8 00	@— —

AT PHILADELPHIA.

Powelton	$7 75

Prices of Foreign Coals.

June, 1871.
Duty $1 25 per ton.
Corrected weekly by PARMELE BROS., No 32 Pine street New York.

Liverpool Gas Caking	$ 9 00@— —
" Cannel	11 50@12 50
" House	— —@16 00
" Orrel	12 00@14 00

Per ton 2,240 lbs., ex-ship.

PRICES FROM YARD.

Liverpool House Orrel, screened	$16 00@17 50
" Cannel, "	18 00@20 00

Per ton 2,000 lbs. delivered.

Freights.—June, 1871.

TO EASTERN PORTS.	Cumberland. From Georgetown.	From Baltimore.	Anthracite. From Philadel'a.	From East Port, Port Johnston, and Hoboken.	From Newburg...	From Rondout....
Amesbury	$2 75		$2 50	$2 00		
Bangor	2 75		2 30	1 75		
Bath	2 75	2 75	2 30	2 00		
Boston	2 50	2 50	2 25	1 75	180	2 00
Bridgeport	2 25	2 25	1 80	1 00	1 10	1 25
Bristol		2 60	2 00	1 25		1 55
Cambridgeport			2 75	2 00		
Derby			2 00	1 20		
Dighton	2 30	2 35	2 30	— —		
East Cambridge			2 35	2 00		
Fall River	2 25	2 25	2 25	1 50	1 40	
Hackensack			1 75	1 00		
Hartford	2 50		2 30	1 50		
Jersey City		2 00	1 40	50	70	
Middletown			2 25	1 25		
Mystic			— —	1 25		
New Bedford	2 30	2 35	2 00	1 25		
Newburyport	2 75		2 40	1 85		1 55
New Haven	2 25	2 25	1 90	1 00	1 10	2 20
New London	2 25	2 25	1 75	1 05		1 25
Newport			2 00	1 25		1 40
New York	2 00	2 00	1 35	50	70	65
Norwalk			1 80	1 00	1 10	
Norwich	2 50	2 25	2 00	1 10	1 40	1 50
Pawtucket	2 50	2 40	2 30	1 75		1 65
Portland	2 50	3 60	2 30	1 75		2 00
Portsmouth, N. H	2 75	2 75	1 45	1 60		1 56
Providence	2 25	2 25	2 00	1 75	1 40	
Rockport			2 10	1 65		
Saco	2 75		2 25	1 75		
Sag Harbor			1 70	1 20	1 10	
Salem	2 60	2 75	2 35	1 50	1 20	1 40
Stamford			2 00	1 00		
Stonington			2 00	1 75	1 10	
Taunton			2 30	1 75	1 20	
Warren			— —	1 40		
Washington			1 25			
TO RIVER PORTS.						
Albany		80			55	
Catskill		70			50	
Cocksackie		70			50	
Coeyman's		70			65	
Cold Spring	2 20	70			30	
Fishkill		70	1 60		30	
Haverstraw					60	
Hudson	2 20	2 25			40	
New York					60	
Nyack			1 75		30	
Poughkeepsie					30	
Rhinebeck						
Rondout					75	
Saugerties			1 60		40	
Sing Sing					75	
Stuyvesant					75	
Tarrytown					75	
Troy					55	
West Point			1 75			
Yonkers					60	

Rates of Transportation to Tide Water.

BY RAILROAD.

TO PORT RICHMOND, PHILADELPHIA.

Philadelphia and Reading Railroad, from Schuylkill Haven	$1 85

MAUCH CHUNK TO ELIZABETHPORT.

L. V. Railroad from Mauch Chunk to Easton	$0 98
C. R. R., N. J., Easton to Elizabethport	1 42
Shipping expenses at Elizabethport	25
Warfage	10
Total	$2 75

MAUCH CHUNK TO PORT JOHNSON.

L. V. R. R., or L. & S. R. R. from M. C. to Easton	$0 98
C. R. R., of N. J., Easton to Pt. Johnson	1 45
Shipping expenses	25
Warfage	10
Total	$2 78

TO HOBOKEN.

L. V. R. R., Mauch Chunk to Easton	$ 98
Morris & Essex R. R. Easton to Hoboken	1 45
Shipping expenses	25
Warfage	19
Total	$2 78

TO SOUTH AMBOY.

L. V. R. R.	98
B. & D. R. R. / Cam. & Am. R. R.	1 40
Shipping Expenses	10
Wharfage	10
Total	$2 78

PENN HAVEN TO ELIZABETHPORT.

L. V. RR. Penn Haven to Easton	1 15
C. RR. of N. J. Easton to Elizabethport	122
Shipping expenses	25
Wharfage	10
Total	$ 2 72

BY CANAL.

Via Schuylkill Canal.

TO PHILADELPHIA.

From Schuylkill Haven	$1 25
" Port Carbon	
" Port Clinton	1 17

TO NEW YORK.

From Schuylkill Haven	$1 90

The Rates of Toll on Lump and Steamer Coal will be ten per cent. less than the above rates. The charge will be per ton of 2240 lbs. No charge less than Forty Cents per ton will be made for any distance. A drawback of thirty cents is allowed on all coal passing Fairmount Locks used at Philadelphia and vicinity.

Via Lehigh Canal.

TO PHILADELPHIA.

Lehigh Canal	$
Freight and towage	
Total	$

TO NEW YORK.

Lehigh Canal	$
Morris Canal	
Freight	
Towing	
Total	$

TO JERSEY CITY.

Lehigh Canal	$
Morris Canal	
Freight	
For re-shipment	
Total	$

Via Delaware and Raritan Canal.

TO NEW YORK.

Lehigh Canal	$
Delaware Division Canal	
Delaware and Raritan Canal	
Freight	
Towage	
Total	$

TO NEW BRUNSWICK.

Lehigh Canal	$
Delaware Division Canal	
Delaware and Raritan Canal	
Freight	
Total	$

Foreign and Provincial Freights.

June, 1871.

Foreign.

Newcastle and Ports on Tyne, per keel of 21 1-5 tons	£14 00@£16 00
Liverpool, 5 per cent primage	13s @15s ton.

TO NEW YORK.

Provincial

Sidney	$ —
Lingan	—
Cow Bay	—
Port Caledonia	—
Little Glace Bay	—

TO BOSTON.

Sydney	$ —
Lingan	—
Cow Bay	—
Port Caledonia	—
Little Glace Bay	—

MARKET REVIEW.

IRON.—The demand for Scotch Pig is still confined to parcels to supply the immediate wants of the consumers, and, with a good stock in dealers' hands, prices are irregular and lower. The sales are 500 tons Eglington at $29@$30, and 200 do. Gartsherrie, $32 currency; and 200 tons Coltness to arrive, $29 50 gold. American continues in demand, but the limited supply restricts business, and prices are inclined to harden; we notice sales of 100 tons No. 1 Hudson at $34; 100 do. No. 1 Poughkeepsie, $34; and 100 do. No. do., $34; and 250 tons Gray Forge, on private terms. Of Wrought Scrap 100 tons No. 1 have been taken at $43 per ton. There has been quite an active inquiry for English new Rails, and prices are steady and firm; sales have been made of 530 tons 56 lb. T at $56 50 gold; 3,700 tons, 50 and 56 lb., to arrive here, and 4,000 do. 56 lb. do., delivered at New Orleans, on private terms. Refined Bar continues in limited demand from store, at our quotations.

The following are the imports of Iron into New York, from January 1st to May 31st, 1871. Compared with the same time in 1870.

From Foreign Ports.	Bar. tons.	Pig. tons.	Sheet: &c. bdls.
	6,608	29,591	124,514
Coastwise	2	16	1,771
Total	6,610 tons.	29,607 bdls.	126 285
Same time, 1870	5,810	14,624	99,489

LEAD.—The demand for Pig is very limited, and we have but to report the sale of 25 tons Spanish at $6 15 gold. Bar 8¼cents, Sheet and Pipe 10½, and Tin-lined Pipe 15, all usual discount to the Trade.

The imports of Lead from January 1st to May 31st, 1871, compared with the same time last year, is as follows:

From Foreign Ports	pigs 240,766
Coastwise Ports	25,349
Total	pigs 266,115
Same time, 1870	211,305

COPPER.—The manufactures of Copper and Yellow Metal are steady at our quoted rates. Ingot has been quiet; Lake is now coming forward pretty freely, but the receipts were contracted for some time ago; sales have been made of 250,000 lb Lake, part for delivery next month, at 21¼ @ 21½ cents, Baltimore and Tennessee is held at the same price as Lake. The Copper Manufacturers are to have a meeting to-morrow, 8th inst.

STEEL.—Both domestic and Foreign are quiet and uniform at old quotations—low qualities English undersell the American as a general thing. The Pittsburgh makers are unusually active—we understand that one single concern, there, made 1500 tons Ingots the first four months of this year.

SPELTER.—Since our last the market has been very quiet, and we have only to notice the sale of 15 tons Silesian at 5¾ cents in gold.

Import of Spelter into New York, Jan. 1st to May 31st—
1871.....plates 114,636 | 1870.....plates 146,464
Decrease 31,828

TIN.—There is little or no speculative inquiry for Pig, and dealers are still pretty well supplied by purchases made some time ago. Prices, therefore, for spot lots are somewhat irregular and nominal, say for Straits 32 cents, English 31¾, and Banca 37¾@38, all gold. Singapore quotations are a little higher, viz., $1 75 per picul; 500 slabs Straits sold, to arrive, at 32¼ cents, and at the close the market seemed to have a firmer tone. Aside from this, we have only to notice the sale of five tons English at a private price. Plates are steady and firm, prices in England being relatively higher than those current here. Ternes are still in small supply, and Coke Tin continues scarce; sales have been made of 200 bxs. Charcoal Terne at $8 gold, and 2,000 do. Charcoal Tin and 1200 do. Vernon, on private terms.

The following is from Messrs. White & Haskell's circular of 1st inst.: The importations for May were 7,200 slabs Straits, equal to 289 tons; 2,000 do. Billiton, or 63 tons; 600 do. Banca, or 17 tons; and 40 tons English L and F. From the East Indies, 15,500 slabs Straits, or 623 tons, 1,400 do. Billiton, or 44 tons, are on the way, and due in all June, July, and August.

ZINC.—Sheet is steady at 9c. in lots from store. Manganese black crude is quoted at 4c. Manganese pyrolusite gray 5c. currency.

METALS.

NEW YORK, June 7, 1871.

IRON.—Duty: Bars, 1 to 1¼ cents ₱ lb; Railroad, 70 cents ₱ 100 lbs.; Boiler and Plate, 1¼ cents ₱ lb; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾ cents ₱ lb; Pig, $7 ₱ ton; Polished Sheet, 3cents ₱ lb; Galvanized 2¼; Scrap Cast, $6; Wrought, 8 per ton.

	Store Prices.
Pig, Scotch No. 1, ₱ ton	29 00@34 00
Pig, American, No. 1	34 00@36 00
Pig, American, No. 2	33 00@34 00
Pig, American, Forge	31 00@32 00
Bar Refined, English and American	74 00@75 00
Bar Swedes, assorted sizes (gold)	85 00@100 00
	Store Prices, Cash.
Bar, Swedes, ord'y sizes	105 00@115 00
Bar, Refined, ord'y sizes	75 00@ 77 50
Bar, Refined, ¼ @ 5-16 inch	82 50@ 85 —
Bar, Common	— @ — —
Scroll	100 00@120 —
Ovals and half-round	95 00@105 00
Band	92 50@ 95 —
Horse Shoe	95 00@ — —
Rods, ¾ to 3-16 inch	82 50@120 —
Hoop	100 00@140 00
Nail rod	— —@6¾ —
Sheet, Russia, as to assortment (gold)	11¾@— 12
Sheet, Single, D. and T. Common	—4¼@— 6
Sheet, Galv'd, Nos. 14 to 26	12@14 and 30 ₱ ct. dis.
" Nos. 27, 28, and 29	15@18 and 30 ₱ ct. dis.
Rails, English (gold), ₱ ton	56 00 @58 00
Rails, American, at Works in Pa	70 00 @72 00

STEEL.—Duty: Bars and Ingots, valued at 7 cents ₱ lb or under, 2½ cents; over 7 cents and not above 11, 3 cents ₱ lb; over 11 cents, 3½ cents ₱ lb, and 10 ₱ cent ad val. (Store prices.)

English Cast (2d and 1st quality) ₱ lb	— 15 @— 18
English Spring (2d and 1st quality)	— 7 @— 10
English Blister (2d and 1st quality)	— 10 @— 17
English Machinery	— 11½@— 14
English German (2d and 1st quality)	— 12 @— 14
American Blister "Black Diamond"	— — @— 12
American, Cast, Tool do.	— 15 @— 16
American, Spring, do.	— 9 @— 11
American Machinery, do.	— 10 @— 11
American German, do.	— 9 @— 11

COPPER.—Duty: Pig, Bar, and Ingot, 5; old Copper 4 cents ₱ lb; Manufactured, 45 per cent. ad val.

	All Cash.
Copper, New Sheathing, ₱ lb	— @— 30
Copper Bolts	— @— 32
Copper Braziers, 16oz. and over	— @— 32
Copper Nails	— @— 36
Copper, Old Sheathing, &c. mixed lots	— @— 19
Copper, old, for chemical purposes	20 @— 21
Copper, American Ingot	21¼@— 21¾
Yellow Metal, New Sheathing & Bronze	— @— 22
Yellow Metal Bolts	24 @— —
Yellow Metal Nails	— @— 22

LEAD.—Duty: Pig, $2 ₱ 100 lbs.; old Lead, 1½ cents ₱ lb; Pipe and Sheet, 2½ cents ₱ lb.

Galena, ₱ 100 lbs	$— @— —
Spanish (gold)	6 12½@6 18
German, do.	6 12½@6 18
English, do.	6 15 @6 50
Bar (net)	— — @8 75
Pipe (net)	— — @10 25
Sheet (net)	— — @10 25

Colwell, Shaw & Willard Tin-Lined Pipe 15 cts. ₱ lb.

SPELTER.—Duty: In Pigs, Bars & Plates, $.150 p. 100 lb.

Plates, Foreign (gold) p. 100 lb.	5 75 @ 6 —
Plates, Domestic p. lb.	— 7 @— 11

TIN.—Duty: Pig, Bars, and Blocks, 15 ₱ cent. ad val.; Plate and Sheets and Terne Plates, 25 ₱ cent.; Roofing 25. ad val.

	Gold ₱ lb.
Banca	— @37¼
Straits	— @32
English	— @31¾

PLATES.

	Fair to Good Brands. Gold.	*Currency.*
I. C. Charcoal, ₱ box	$8 50 @8 75	$9 75 @10 25
I. C. Coke	7 50 @8 00	8 25 @ 9 25
Coke Terne	6 12½@7 12½	7 00 @8 25
Charcoal Terne	7 75 @8 50	9 00 @ 9 75

ZINC—Duty: Pig or Block, $1 50 ₱ 100 lb.; Sheet, 2½cts. ₱ lb.

Sheet, No. 9 to 11 Foreign ₱ lb.	— 8¼@—

Mining Stocks.

NEW YORK, June 7, 1871.

The Mining Stock Board quotes Petroleum Stocks decidedly lower than for last report, if we may except Home and Northern Light, which have slightly advanced. No transactions are reported, and we give the following table as furnished by the Board:

PETROLEUM STOCKS.

	BID.	ASKED.
Bergen Coal and Oil	13	—
Bennehoff Run	20	—
Blood Farm	—	—
Breevoort	30	—
Bliven Oil	35	—
Buchanan Farm	40	—
Central	65	70
Clinton	—	—
Home	165	175
Phillips Pet	—	20
Rynd Farm	35	—
United Petroleum Farms	26	28
United States	60	70
National	—	—
New York & Allegheny	55	—
Northern Light	80	—
Pithole Creek	—	—
Rathbone Oil	—	—
Second National	—	—
Sherman & B	—	—
Tarr Farm	20	—
Hoffman	9	—

GOLD STOCKS.

The market in Gold Stocks is firm and active. Sales of 300 La Crosse were made at 20 and 100; Smith and Parmlee at 34. The following is the report in full:

	BID.	ASKED.
American Flag	18	30
Bates & Baxter	30	—
Benton	—	10
Black Hawk	20	29
Central Gold	9	10
Cons Gregory	50	55
Grass Valley	13	15
Gunnell	17	—
La Crosse	18	22
Liberty	—	—
Mariposa prf	—	—
Montana	—	—
Rocky Mount	—	—
Quartz Hill	26	34
Smith & Parmlee	36	45
N. Y. & Eldorado	—	—

San Francisco Stock Market.

"BY TELEGRAPH."

The following is a full report of the San Francisco Mining Stock Board, dated California, June 6th. Crown Point and Kentuck have still further advanced. Imperial and Amador are not quoted. All other stocks on the list have materially declined, compared with our last report.

Savage	43
Yellow Jacket	66¾
Kentuck	116
Chollar Potosi	43¾
Gould & Curry	82
Belcher	128
Imperial	—
Amador	—
Crown Point	300
Hale & Norcross	—

VERMONT SLATE TRADE.

REPORT of Slate Shipped from Middle Granville, N. Y., via the R. & S. R. R., for the week ending June 3, and for the year 1871.

ROOFING SLATE.

NO. OF SQUARES.	Week.	Prev'ly.	Year.
†Penrhyn Slate Co	100	1,631	1731
New York and Middle Granville Slate Co	165	1,555	1730
†American Slate Co	....	....	....
Benj. Williams	110	575	685
Jones & Williams	....	60	60
Eagle Slate Co	36	60	95
Mettowee Slate Co	....	265	265
Albany Slate Co	....	245	245
H. W. Hughes	....	30	39
Total	....	....	—

A Historical Note on the Method of Least Squares.

By CLEVELAND ABBE, A. M.

It is well known that the "Method of Least Squares," although first published in printed form by LeGendre in 1806, in his "Nouvelles Methodes," was first invented by Gauss as early as 1795, and had for years been taught by him in his lectures to his students at Göttingen. It was, however, some years before the Gaussian method came into general use, and especially were English scholars very slow to acquaint themselves with its merits. I have, therefore, been much interested in finding that, in 1808, Professor ROBERT ADRIAN, at that time in New Brunswick, N. J., published the method of least squares in the *Analyst*, having been independently led to this invention by the study of a prize problem offered some months previously in that periodical.

As the editor of, and chief contributor to, the *Mathematical Correspondent*, the *Analyst*, and the *Mathematical Dairy*, and as Professor in Columbia College and in Pennsylvania University, as well as by his correspondence, Dr. ADRIAN is well known to have contributed powerfully to the progress of Mathematical studies in this his adopted country—(he was born and educated in Dublin)—and his apparently independent demonstration of the method of least squares seems quite in accordance with the originality shown in many other of the elegant solutions offered by him to the different problems on which he busied himself. A number of interesting and probably valuable mathematical manuscripts still remain in the possession of his family at New Brunswick, New Jersey, which it is to be hoped may some day see the light. At present I would offer toward the history of mathematics in America the following extracts from the *Analyst* and other publications.

The problem "to correct the distances and bearings of a survey, so as to deduce the most probable area of the enclosed field," had been proposed by Professor PATTERSON in a previous number of the *Analyst*, and after being a second time renewed as a prize question, was at length in number IV, solved by a course of special reasoning, by Dr. BOWDITCH, to whom Dr. ADRAIN awarded the prize. Dr. BOWDITCH'S results coincided with what would have been deduced had the Gaussian method been applied to this case. Immediately following Dr. BOWDITCH'S special solution the editor adds his own solution of the more general problem as follows: (The *Analyst*, pp. 93—95 inclusive).

"Research concerning the probabilities of the errors which happen in making observations."

"The question which I propose to resolve is this: supposing AB to be the true value of any quantity of which the measure by observation or experiment is Ab, the error being Bb; what is the expression of the probability that the error Bb happens in measuring AB?

Let AB, BC, etc., be several successive distances of which the values by measure are Ab, bc, etc., the whole error being Cc; now supposing the measures Ab, bc, to be given and also the whole error Cc, we assume as a self-evident principal, that the most probable distances AB, BC are proportional to the measures Ab, bc; and therefore the errors belonging to AB, BC are proportional to their lengths, or to their measured values Ab, bc. If therefore we represent the values of AB, BC or of their measures Ab, bc by a, b, the whole error Cc by C, and the errors of the measures Ab, bc by x, y, we must for the greatest probability, have the equation $\frac{x}{a}=\frac{y}{b}$. Let X and Y be similar functions of a, x, and of b, y, expressing the probabilities that the errors x, y happen in the distances a, b; and, by the fundamental principle of the doctrine of chance, the probability that both these errors happen together will be expressed by the product XY. If now we were to determine the values of x and y from the equations $x+y=E$ and XY=maximum, we ought evidently to arrive at the equation $\frac{x}{a}=\frac{y}{b}$: and since x and y are rational functions of the simplest order possible of a, b, and E, we ought to arrive at the equation $\frac{x}{a}=\frac{y}{b}$ without the intervention of roots, in other words, by simple equations; or, which amounts to the same thing in effect, if there be several forms of X and Y that will fulfill the required condition, we must choose the simplest possible, as having the greatest possible degree of probability.

"Let X', Y' be the logarithms of X and Y, to any base or modulus; and when XY = max. its logarithm X'+Y' = max. and therefore $\dot{X}'+\dot{Y}'=0$, which fluxional equation we may express by $X''\dot{x}+Y''\dot{y}=0$; for as X' involves only the variable quantity x, its fluxion $\dot{X}'$ will evidently involve only the fluxion of x; in like manner, the fluxion of Y' may be expressed by $Y''\dot{y}$; and from the equation $X''\dot{x}+Y''\dot{y}=0$ we have $\dot{X}''\dot{x}=-Y''\dot{y}$: but since $x+y=E$, we have also $\dot{x}+\dot{y}=0$, and $\dot{x}=-\dot{y}$, by which dividing the equation $\dot{X}''\dot{x}=-\dot{Y}''\dot{y}$, we obtain $X''=Y''$.

"Now this equation ought to be equivalent to $\frac{x}{a}=\frac{y}{b}$; and this circumstance is effected in the simplest manner possible, by assuming $X''=\frac{mx}{a}$, and $Y''=\frac{my}{b}$; m being any fixed number which the question may require.

"Since, therefore, $X''=\frac{mx}{a}$, we have $X''\dot{x}=\dot{X}'=\frac{mx\dot{x}}{a}$, and taking the fluent, we have $X'=a'+\frac{mx^2}{2a}$. The constant quantity a' being either absolute, or some function of the distance a

"We have discovered, therefore, that the logarithm of the probability that the error x happens in the distance a is expressed by $a'+\frac{mx^2}{2a}=X'$, and consequently the probability itself is $X=e^{X'}=e^{\left(a'+\frac{mx^2}{2a}\right)}$. Such is the formula by which the probabilities of different errors may be compared, when the values of the determinate quantities e, a', and m are properly adjusted. If this probability of the error x be denoted by u, the ordinate of a curve to the abscissa x, we shall have $u=e^{\left(a'+\frac{mx^2}{2a}\right)}$, which is the general equation of *the curve of probability*.

"When only the maximum of probability is required, we have no need of the values of e, a', and m; it is proper, however, to observe that m must be negative. This is easily shown. The probability that the errors x, y, z, etc., happen in the distances, a, b, c, etc., is $e^{\left(a'+\frac{mx^2}{2a}\right)}\times e^{\left(b'+\frac{my^2}{2b}\right)}\times e^{\left(c'+\frac{mz^2}{2c}\right)}$, etc., which is equal to $e^{(a'+b'+c', etc.,+\frac{mx^2}{2a}+\frac{my^2}{2b}+\frac{mz^2}{2c}, etc.)}$, and this quantity will evidently be a maximum or minimum as its index or logarithm is a maximum or minimum; that is, when $\frac{m}{2}\left\{\frac{x^2}{a}+\frac{y^2}{b}+\frac{z^2}{c}, \text{etc.},\right\}$ = a maximum or minimum.

Now when $x+y+z$, etc., $=E$, we know that $\left\{\frac{x^2}{a}+\frac{y^2}{b}+\frac{z^2}{c}, \text{etc.},\right\}$ = minimum, when $\frac{x}{a}=\frac{y}{b}=\frac{z}{c}$, etc., and therefore $-\left\{\frac{x^2}{a}+\frac{y^2}{b}+\frac{z^2}{c}, \text{etc.},\right\}$ = maximum.

When $\frac{x}{a}=\frac{y}{b}=\frac{z}{c}$, etc., it is evident therefore that m must be negative, and as we may for the case of maxima use any value of it we please, we may put $m=-2$, and the probability of x in a is $u=e^{\left(a'-\frac{x^2}{a}\right)}$. If we put $\frac{m}{2a}=-1$ and $a'=f^2$, we have $u=e^{(f^2-x^2)}$ for the equation of the curve of probability; we suppose $f^2=0$, the ordinates u will still be proportional to their former values, and we shall have $u=e^{-x^2}$, or $u=\frac{1}{e^{x^2}}$, which is the simplest form of the equation expressing the nature of the curve of probability."

Immediately following the above general solution by Dr. ADRIAN, there are given applications of this method to the following problems:

1. To find the most probable value of any quantity of which a number of direct measures are given.
2. To find a most probable position of a point in space.
3. To correct in the most probable manner the dead reckoning at sea.
4. To correct the bearing and distances of a field survey.

The article closes on p. 109 of the *Analyst* with the following: "I have applied the principles of this essay to the determination of the most probable value of the earth's ellipticity, etc., but want of room will not permit me to give the investigation at this time." The investigations here alluded to were, however, long afterwards published, *i. e.*, in 1817, in vol. i, new series, of the "Transactions of the American Philosophical Society," and are given in two papers (Nos. IV and XXVIII) of that volume. The preceding note, as well as the dates written on the manuscripts (which are still preserved by the Hon. G. B. ADRIAN, of New Brunswick), show that these two investigations were completed in 1808. The first of the papers here alluded to is entitled "Investigation of the figure of the earth and of the gravity in different latitudes," from which, as printed in the Philadelphia *Transcript*, we make the following extract: "Having in the year 1808 discovered a general method of resolving several useful problems by ascertaining the highest degree of probability, when certainty cannot be found, I shall here apply that method to the determining of the earth's ellipticity, etc." The author's computation is based on the lengths of the seconds pendulum as given by LAPLACE (Mec. Cel., iii), and having stated the problem before him, he says: "This is accomplished by a rule published by the writer in the *Analyst*, in 1808. The resulting ellipticity $\left(\frac{1}{319}\right)$ he shows to differ from that deduced by LAPLACE $\left(\frac{1}{376}\right)$ because of numerical errors in the computation of the latter; having corrected these, he deduces the ellipticity $\frac{1}{319.5}$ by LAPLACE'S own method—showing that the two methods conduce to nearly the same result.

The second of the articles in the Philadelphia *Transcript*, is entitled "A Research concerning the Mean Diameter of the Earth." In this the author seeks the sphere which most nearly coincides in various specified peculiarities with the actual terrestrial spheroid; the diameter of this sphere he determines to be 7918.7 miles. This numerical result is based upon some earlier computations, the details of which are not given, but of which he says: "Having determined the most probable axis of the terrestrial spheroid from the measurements of a degree of the meridian by a method which I discovered several years ago and published in the *Analyst*, the resulting mean radius was found to be 3959.69 English miles.'

The mathematical works published by Dr. ADRIAN are so rarely to be met with, that it was necessary to make these long extracts in order to establish the conclusion to which we have arrived, *i. e.*, that we must credit Dr. ADRIAN with the independent invention and application of the most valuable algebraical process that has been invoked to aid the progress of the exact sciences.

WASHINGTON, February 22, 1871.

New Method of Electrically Exploding Torpedoes.

THE progress of the torpedo question having hitherto been carefully noted in our columns, it is natural that our readers should expect to find any new feature in that direction discussed by us. We, therefore, have now to record another step in the right direction, which has been made by Captain ANDREW NOBLE, who has done so very much in promoting the science of gunnery. It is pretty generally known that hitherto it has been the practice, in the arrangement of submarine torpedoes, to connect every mine with the firing battery or other electrical exploding agency, by means of a distinct insulated wire or cable. Captain NOBLE, however, uses but one cable for the explosion of any number of torpedoes, and the manner in which he effects this is as follows: The insulated cable is connected with a number of branch insulated wires corresponding to the number of torpedoes which are to be laid down. These torpedoes are so constructed that any one of them is exploded when struck by a passing ship, by the completion of an electric circuit through the insulated wire. Upon the explosion of any one of the torpedoes, it is at the same instant disconnected from the electrical arrangement, so that its explosion in no way interferes with the liability of any one of the other torpedoes to be subsequently exploded by collision with a vessel. In practice, Captain NOBLE makes the electrical communication between each torpedo and the insulated wire through an Abel fuse, which, together with the joints which connect it with the torpedo and the insulated cable, is inclosed in a water-tight insulating casing. When the torpedo is exploded by completing the electric circuit, the fuse inclosed in the insulating box is simultaneously exploded thereby, and the electric communication of that particular torpedo with the insulated wire is instantaneously severed. The same result is also obtained by Captain NOBLE with a platinum or fine iron wire, or any other electrical fuse in place of the Abel fuse, the special points of the invention—which has been patented—being the electrical explosion of one or a series of torpedoes without disturbing the rest, and the severance of electrical communication by means of the insulating casing.—*Journal of the Telegraph.*

Iron in Architecture.

SINCE the first introduction of iron among building materials, numberless have been the attacks made upon those employing it. Some of these attacks have been sensible and well conceived—others entirely without cause, and unworthy of reply. The questions involved in the use of iron relate to its value as a lasting and strong material, and the conditions under which it may be employed without violating the known and universally-recognized laws of appropriateness in construction. As regards the superiority of iron over any other material for performing a certain part in architecture, there can exist no doubt. Only the necessities of construction have made its use so general, especially in America. Casting is so notably adapted to resist crushing weight, that slim columns perform the work where, of another material, a heavy wall would be required. Rolled iron possesses the same qualities when used for beams. Hence the demands of trade, where space is required for display, necessitate the use of the material which will support a given weight and occupy the least room. Especially is this the case with store-fronts, where only slim columns furnish a support and obstruct but little the view obtainable through broad glass windows of the goods beyond. This object could not be secured were any material employed for the columns which did not unite strength with lightness. It is evident, then, that iron must always occupy a place in architecture which cannot be held by any other material.

The faults committed by those who use iron in construction, generally arise from the fact that they do not fully consider its capabilities and requirements when artistically treated. Iron is strong, and conveys to the mind an idea of strength; but massiveness of appearance should not be the desired end when it is used in buildings. Here is a common error. From the nature of the metal, it must, to insure durability, be protected from contact with the atmosphere; painting becomes necessary. The character of this painting is an important thing to be considered. The ignorant designer causes the iron to be painted white, in imitation of marble, or brown, to make it resemble sandstone, or gray, to secure the appearance of granite. No greater blunder could be committed. With almost equal propriety might a chimney be painted in imitation of wood. Iron cannot be made to resemble stone for any great length of time, looking at its surface alone; and even could this be done, a glance at the slender columns supporting immense weight would cause their proportions to appear unsafe and ridiculous. But iron can be made to appear light and graceful, and, suited as it is for such an effect, it should be the aim of an architect to produce with it the style of building to which it is so well adapted. Consistency in architecture is desirable—more, it is absolutely necessary; and when iron is treated, not as stone or wood, but as metal, there will be no violations of any recognized law. There may be architectural effects, and a due observance of rules of the different orders in iron as in stone. An acanthus leaf is as much of an incongruity in stone as in metal, and so with all other imitations of natural objects. But in all these there is no attempt at deception. We are not asked to believe that the objects represented are more than imitations. The acanthus leaf is not colored green to convey the idea that it is a vegetable production. It would be false and inconsistent to attempt so palpable a deceit. But it would be hardly more foolish to do this than to paint iron in imitation of stone or wood. Iron may be painted, says the *American Builder*, and it may be made beautiful in itself. It may properly exhibit bright colors, and be picked out with gold and silver until its surface sparkles. It is for such showy, graceful effects that this metal should be used.—*American Railway Times.*

THE ENGINEERING AND MINING JOURNAL.

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ROSSITER W. RAYMOND, Ph. D., WILLARD P. WARD, M. E., } Editors.

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THE SCIENTIFIC PUBLISHING COMPANY.

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The Pittston Calamity.

FURTHER evidence confirms the opinion we expressed last week, with regard to the causes and bearings of the accident at the West Pittston shaft, on the 27th ultimo. That the law was not literally complied with by the owners of the mine is evident; but it is not clear that they were grossly negligent as to the safety of their men. Mr. KENDRICK, the superintendent, deposes that they "had no system as to how many men had to be down at one time. It was discretionary with the men." Apparently the proprietors winked at the transgression of the law in respect of the number of workmen, in view of their own necessities and those of the miners, after so long a suspension. As for Inspector WILLIAMS, he has been cruelly handled by some of the newspapers; but it is not right to make him the scapegoat for the sin (if it be a sin) of a whole community. We repeat that there have been many other collieries besides the West Pittston working with single shafts, and more men in them than the law allows. Inspectors give warning, as it appears Mr. WILLIAMS did; the mine-owners warn their men, as it appears BLAKE & Co. did; but the men chose to take the risk and the consequences. Before the Pittston disaster, Mr. WILLIAMS attempted, in one instance within our knowledge, to enforce the law against a colliery with a single shaft, which was working over one hundred, instead of twenty men. All that the inspector can do is to give warning, and if this is disregarded, apply to the courts for an injunction. In the case referred to, Mr. WILLIAMS applied for an injunction and did not get it.

Since the catastrophe at Pittston, the inspectors have been, of course, very active; and a number of mines have been warned, and have temporarily discharged their extra workmen. In one instance, Inspector BLEWITT notified the proprietor of a certain colliery that he was violating the law in this respect, and the miners immediately held an indignation meeting! How can men be protected, if they resent the operation of the law devised for the purpose at their own request, and executed by men of their own choice?

If Mr. WILLIAMS had said nothing, or had made a temperate statement of the causes which led him (in common with other inspectors) to be a little lax in the discharge of his duties, the case would have been no worse for him than for the multitude of operators and miners who are guilty of the same technical transgression. But he has chosen to vindicate himself by assailing the coroner's jury, the press, and everybody else on whom he could shift the blame, a part of which certainly belongs to him. He asserts that he was not aware of the violation of the law at West Pittston—a statement which discredits his intelligence, to say the least; since a miner of so much experience should have seen at a glance that the amount of coal coming out of the shaft was more than twenty men could extract. The operators were evidently pushing the production as far as possible, to make up for time lost during the strike. They were adding fresh men every day, and at the time of the accident, the men appear to have been in the habit of going down when they liked, without being counted.

The appeal for charitable contributions in aid of the families of the victims is one which should naturally touch the sympathies of the public. Yet we note that the response is not enthusiastic. This is, perhaps, partly owing to the fact that the matter has not been presented, and contributions solicited, by men of well-known social standing and integrity. People will not blindly bestow charity. There is a Workingmen's Benevolent Association in the coal regions which boasts its 30,000 members, and was ostensibly organized to secure the better protection of the lives of miners, and to provide for the disabled and infirm, and for the destitute families of those who die. This Association exacts regular contributions from its members for these purposes; but, unfortunately, when it has accumulated sufficient funds, it goes on an expensive kind of spree, called a "strike," and the widows and orphans suffer for it. We observe that the West Pittston miners have declared (in substance) that the money contributed by the public in this case will not be expended in any contest with their employers, and perhaps this assurance will encourage the benevolent to bestow relief on the unfortunate and innocent sufferers; but we must point out to the workingmen that if they had not foolishly wasted their funds in an attempt to wrong the public, they would not now need to be mendicants before the public. When their "Benevolent Association" stopped the collieries in winter weather, expressly in order to put up the price of coal, they relied on the inconvenience and suffering which this measure was certain to produce, as a legitimate element of power in their hands.

Nevertheless, it is unjust to visit upon the innocent victims of this calamity the sins of others; and we trust that the public will be more truly benevolent than the Association.

The saddest thing about the whole affair is the undeniable fact that the miners who lost their lives might all have been saved, but for their ignorance of the principles of ventilation, which led them to adopt the worst measure they could possibly have chosen, namely, to wall themselves into a small, hermetically closed space, where they were certain to die, as soon as the limited supply of oxygen was exhausted. This is exactly what was done in the Avondale mine, with the same fatal result. The miners at West Pittston even kept several mules with them, to vitiate the air still faster; and so small was the space in which they huddled together, that three of the men were actually kicked to death by the mules, probably after they had become too weak to get out of the way.

Now, there is no reasonable doubt that these men might have saved themselves by simple means, requiring only ordinary intelligence. We shall try to explain this proposition so that any reader may comprehend it.

The shaft at West Pittston was divided by partitions or brattices into several parts. We need refer only to the division of the upcast, or passage for the air out of the mine, and the downcast, or passage for the air into the mine. The mine was ventilated by a current of air passing down the downcast, through the workings and then up the upcast. Of course, the upcast and downcast were not allowed to communicate with each other, except by the devious route through the mine, which the air was expected to follow. While the breaker was on fire, there was a strong draught up one of these passages (it is immaterial which) and down the other. Hence the smoke and gases of combustion poured through the mines, just as fresh air would do under ordinary circumstances. To escape them, the miners retired to a part which could be shut off, and walled themselves in, beyond hope of succor. Where they were, the air grew rapidly worse; and *none of the measures taken at the surface to put fresh air down could help them in the slightest degree.* Long before they were dead, in all probability, the air was better in front of their barricade than behind it.

Now what they should have done was to break through the the partition between the downcast and the upcast at the bottom of the shaft, *establishing a short circuit for the smoke and gas*, and then, by closing the main gangways, shut themselves into, not a corner of the mine, but *the whole mine*, the air of which would not have grown too bad to breathe in less than twenty-four hours. Long before that time, the smoke and gas would have ceased, and the whole party would have been rescued.

Similar ignorance was shown by the miners on the surface, with regard to measures of relief. The timbers in the shaft were on fire; and it was unanimously agreed by all the mining bosses and engineers present that the first thing to be done was to throw water into the shaft; in order, first, to put out the fire; secondly, to create an artificial current of fresh air; thirdly, to absorb the carbonic acid in the shaft. This thoroughly judicious plan was opposed by the crowd of miners, from a superstitious notion that it would injure their comrades below. They brandished the axes with which they had been working at the breaker, and threatened to kill any man who put water in the shaft. In this way, they succeeded in delaying for more than an hour an imperatively necessary and wholly beneficial measure. It is true that the workmen below had put themselves beyond relief; and hence we cannot say that this stupidity directly caused any loss of life, unless, it may be, that of the boy, who died outside of the barricade.

We are supported in these statements and opinions by the evidence of Mr. R. P. ROTHWELL, one of the best mining engineers in the country. Mr. ROTHWELL was present during the fire, and descended with other brave men into the mine, to rescue the living and recover the bodies of the dead. He read the history of the case before it could be obliterated; and was able to interpret what others may have seen without comprehending.

The most important lesson taught by this sad occurrence is the necessity of more intelligence among common miners. It is evident that they do not understand the laws of nature nor respect the laws of the State. Obedience to either would have saved their lives. They need to be educated; and education would protect them better in every respect than stacks of statutes or legions of leagues.

The Ferrie Iron Furnace.

THOSE interested in the manufacture of iron will doubtless remember having seen several short notices of this new furnace in our columns, as well as a report of the discussion of its merits before the English Iron and Steel Institute. It will also be remembered that the improvement claimed, consisted in dividing the furnace by means of internal walls into chambers or flues, in which the raw coal was coked by the waste gases from the smelting zone of the furnace.

A report has recently been made by Mr. HUNTER, of the Coltness Iron Works, where the new furnace has been tested for six months, which confirms the one previously made of the trial at the Monkland furnace.

If the results claimed for the furnace are confirmed by further trials, which will doubtless soon be made in Scotland, the Ferrie furnace will advance the manufacture of iron in this country, infinitely more than the *Codorus ore* or the furnace *five feet in diameter and fifty feet high*, recently puffed in the *Tribune*.

The bituminous coal fields are doubtless destined within a few years to yield the fuel for the smelting of the greater part of the iron produced in this country. Much of this coal is not adapted, in its raw state, to the manufacture of iron in the furnaces in ordinary use, but must first be coked. It is in the saving of the cost of the coking process that the chief advantage of the new furnace consists. The main argument used against the invention in the meeting of the Iron and Steel Institute, before alluded to, was that nothing was accomplished by it that could not have been more easily attained by simply building higher furnaces on the old plan.

We make the following extracts from Mr. HUNTER'S report: "The Ferrie furnace maintained a saving in coal of 33.76 per cent., in ironstone of 5.80 per cent., [We should like to know how this saving is brought about.—ED.] and in limestone of 2.80 per cent. over the Coltness furnace, being equal in saving to something like nearly 9s. per ton of iron; and this is altogether exclusive of the gases produced by this new system, which are fully utilized for heating purposes, and which may be estimated at least to be equal to 2s. 6d. per ton of iron produced. In England, with a superior coal, 22.75 cwts. of coke are required per ton of iron; and if the quality of the material obtained from Scotch coal is reckoned at 54 per cent.—from, say, 34 cwts. of coal—it shows that Scotch makers are by this process enabled to make a ton of No. 1 pig iron on 18 cwts. of coke, against 22.75 required in England. Not only, therefore, has a competing level in the market been attained by Mr. FERRIE for Scotch iron-masters, but an undoubted superiority has been demonstrated over the best English furnaces at present in blast. By the self-coking of the coal in the furnace, double the quantity for heating purposes is also obtained as compared with the quantity got from prepared coke, the fixed carbon of the coal being at the same time retained in the smelting chamber, and not allowed to escape, as in the coke ovens, during the preparation of this form of fuel. Such facts as these cannot but exercise an important influence upon the future coal and iron trade of the country. The iron produced is better and richer in carbon, and there is an immense saving in coal, ores and lime, which must ere long act materially upon those important trades. When this process becomes more generally adopted in Scotland, where the annual make of pig iron exceeds a million tons, the saving in coal alone yearly will be about one million tons; in iron ores, 125,000 tons; in limestone, 50,000 tons; in dross, 500,000 tons; or equal in money to something like a saving of £471,250 annually. I have never in my experience seen any furnace work more steadily or satisfactorily than the Ferrie furnace did during the period of the experiment; and, as the internal construction of the flues for preparing the materials seems to be as secure and perfect after six months' trial as on the day when they were built, I see no reason to doubt their stability. This opinion has been still further strengthened by the Coltness Company having agreed to commence operations immediately in the construction of two furnaces on the same principle, having paid Mr. FERRIE a very handsome royalty for the use of the patent."

The Glasgow *Herald* endorses the invention in the following terms: "Mr. FERRIE has never claimed any great originality in his patent; but he has done what no other man has yet succeeded in doing—he has adapted the English furnace, with certain improvements, to the production of first-class iron by the raw and inferior Scotch coal, without any attempts at previous coking."

The Pacific Glaciers Again.

PORTLAND, Oregon, May 19, 1871.

SIR: Having been favored with a copy of your journal of the 2d inst., allow me to make a few remarks in reference to the article "Glaciers in Oregon and Washington." You state that there is as yet no proof that I published my discovery of glaciers to the world. I am under a strong impression that in my previous communication to you, mention was made of an article entitled "Mountaineering on the Pacific," which I published in Harper's Magazine for November, 1869, more than a year before Mr. Clarence King's publication of his alleged discovery. In the above-mentioned article, which gives an account of my ascent of Mt. Baker, the discovery of glaciers was mentioned, though not dwelt upon as such, from the fact that I was not aware of their supposed non-existence. As a foreigner, totally unacquainted with America, I never dreamt but that they had long ago been discovered, especially as they were found many years back in nearly the same latitude on the other side of the boundary in British Columbia, and all along the coast up into Russian territory.

I am, Sir, your obedient servant,

EDMUND T. COLEMAN.

Obituary.

JOHN M'LEOD MURPHY.

It is with regret that we announce the sudden death of a well-known and esteemed engineer, Mr. JOHN MCLEOD MURPHY, at his residence at Harlem, on the 2d inst.

Mr. MURPHY was born at Northcastle, Westchester county, on the 14th day of February, 1827. In the year 1841 he entered the United States Navy as a midshipman, and remained in service until March, 1852. During this time he graduated at the Naval Academy, and was actively engaged during the Mexican war. In 1850–51, while still in the navy, Mr. MURPHY accompanied the expedition for the exploration of the Isthmus of Tehuantepec, under the direction of Major BARNARD of the U. S. Engineers, and was assigned by that officer as assistant engineer in the hydrographic division under Lieut. TEMPLE.

After aiding in the survey of the Coalzacoalcos and Jaltepec rivers, Mr. MURPHY's division crossed to the Pacific and surveyed the ports of La Ventosa and Salma Cruz. He next explored the Rio del Corte and the country bordering Chiapas, and collected data for the official reports on the botany, mineralogy, and productive industry of the Isthmus. In May, 1851, he explored the river Uspanapa, and the country east of that tributary to the boundary line of the State of Tabasco. In July the expedition returned to the United States, when Mr. MURPHY was elected a member of the American Institute, and spent some six months in preparing the reports for publication.

The smallness of the navy offering but little prospect of advancement, in March, 1852, Mr. MURPHY resigned, and engaged in the profession of civil engineering. His education as an engineer not being complete, he applied himself to study, acting meanwhile as an associate editor of the New York *Freeman's Journal*. In November, 1853, he was employed by President PIERCE as confidential agent of the Government to visit the capital of Mexico in connection with the settlement of the Messilla Valley dispute, and performed successfully the duties he was charged with. On his return home he resumed his professional pursuits, and in 1855 was appointed a city surveyor, and employed in the construction of sewers, piers, city railroads, development of streets, etc. During the following year he was appointed Constructing Engineer at the United States Navy Yard in Brooklyn, where his duties involved many important questions. In July, 1858, Mr. MURPHY was chosen Superintending Engineer and Agent of the Louisiana Tehuantepec Company of New Orleans, and, with a force of 140 whites and 800 Indians, constructed a wagon road across the Isthmus, and thus opened the route for the transmission of mails and passengers to California. During May, 1859, he made a survey of the port of Huatulco, on the southern coast of Oaxaco.

On Mr. MURPHY's return to New York, he was elected to the State Senate from this city, serving one term with credit.

In the year 1860 he made the survey for the improvement of Harlem River, under the supervisors of the county of New York.

Upon the breaking out of war in 1861, Mr. MURPHY offered his services to the Government, and was commissioned colonel of the Fifteenth Regiment of New York Volunteer Infantry, and served in Virginia with it for nearly two years, during which time he participated in the several campaigns, especially in the memorable one on the Peninsula, and remained with the Army of the Potomac until after the battle of Fredericksburg, in December, 1862. Col. MURPHY's regiment was employed as a regiment of engineers. Finding Mr. LINCOLN willing to restore him to the naval service, Colonel MURPHY declined a brigadier-generalship, and in January, 1863, accepted a provisional appointment as lieutenant in the navy. He was ordered to report to Admiral Foote for the purpose of recruiting men for service with the Mississippi Squadron, and in two weeks enlisted 450 sailors, with whom he was ordered to join Admiral PORTER, which he did. In March he was assigned to the command of the iron-clad Carondelet, and participated in all the naval operations until March, 1864, when, being in feeble health, he resigned and retired to private life. Mr. MURPHY subsequently paid another visit to the Isthmus of Tehuantepec, explored the range of Tuxtla mountains, and traced out the mineral zone, which included the petroleum springs of the Isthmus. In July he returned to the United States, but in April, 1866, he again visited Tehuantepec, and was employed in developing the railroad and telegraph lines between the Gulf of Mexico and the Pacific Ocean. This work occupied him until May, 1867, when he came back to New York, and in August of the same year was nominated and confirmed as United States Consul at Tabasco, but declined the appointment. From that time to his death he remained in New York, variously occupied in literary and engineering pursuits.

During the last six years of his life Mr. MURPHY gave considerable attention to the study of petroleum and asphalt. While engaged upon the survey of the Isthmus of Tehuantepec, several oil springs and asphalt deposits were brought to his notice, of which he subsequently became the owner.

Personally, Mr. MURPHY was a most estimable gentleman, kind-hearted, charitable and hospitable and noted for his strict integrity. He had seven children, four of whom, with his wife, survive him. The death of Mr. MURPHY will be deeply deplored by a numerous circle of friends, to whom he had attached himself by his many amiable and sterling traits of character.

The Belgium Iron Trade.

DURING the year 1870 there were exported from Belgium, according to the official tables, 8,232 tons of pig and scrap iron, 122,926 tons of rails, 20,705 tons of plates, and 75,648 tons of other kinds of rolled iron. Of this total exportation 62,755 tons were sent to Russia, 57,994 to the Zollverein, 28,902 to the Netherlands, 13,318 to England, 30,349 o France, 17,810 to Turkey, and 11,924 to the United States

The Physical Constitution of the Sun.

By Professor W. A. NORTON.

AMONG the recent theories of the physical constitution of the sun, based on the later discoveries, astronomical and spectroscopic, that propounded a few years since by M. FAYE* has been most favorably received. It is an essential feature of this theory that the sun's mass consists wholly, or in a great degree, of gases or vapors; and that a process of interchange of solar matter between the interior and the photosphere is in incessant operation, in ascending and descending currents, by which the solar radiation is maintained. In a paper by J. HOMER LANE, on "The Theoretical Temperature of the Sun," etc., published in July, 1869, it is elaborately argued, and appears to be successfully maintained, that the great rapidity of circulation required by this theory cannot subsist consistently with the received laws of gaseous circulation. Quite recently another theory of the sun's physical constitution has been propounded by Professor F. ZÖLLNER, of Leipzig, based mainly on the well-established fact that the solar protuberances, conspicuously visible in total eclipses, and observable at all times with the aid of a spectroscope, are most of them due to violent eruptions of masses of incandescent hydrogen. † He remarks that "it is impossible, without passing beyond the well-known analogies necessary for the explanation of cosmical phenomena, to assign any other cause to these eruptions than the difference of pressure of the gases emanating from the interior and from the surface of the sun. To make such a difference of pressure possible, it is necessary to admit the existence of a separating stratum between the inner and outer strata of hydrogen—the latter of which, as is well known, forms an important portion of the solar atmosphere. In reference to the physical constitution of this stratum, we must furthermore assume that it cannot be gaseous, and must therefore be either solid or liquid." He remarks further, that "with regard to the inner masses of hydrogen bounded by that stratum, two suppositions are possible, namely: 1. The whole interior of the sun is filled with incandescent hydrogen gas, which would make the sun an immense bubble of hydrogen, surrounded by a liquid glowing envelope. 2. The masses of hydrogen, bursting out into protuberances, are local collections in bubble-like caverns, which form in the superficial layers of a liquid glowing mass, and burst through when the pressure of the confined gas increases." Professor ZÖLLNER adopts the latter supposition as the more probable of the two.

This theory may furnish an adequate supposable cause for the observed eruption of incandescent masses of hydrogen, but its fundamental hypotheses have no secure ground to rest upon. The notion that the sun's photosphere is in the liquid state, is irreconcilable with the astonishing rapidity with which changes often occur on the sun's surface, and also with the fact that the vast elevated masses, seen as the faculæ, occasionally retain the same position for several days; and, though suggested long since, has not, to my knowledge, been adopted by any astronomical observer. No hypothesis of the possible origin of the sun's spots, upon this idea, has been framed that affords a satisfactory explanation of even their more conspicuous features and phenomena. To this remark the theory advanced by Professor ZÖLLNER, namely, that "the nucleus of the solar spots is a scoriaceous product of local cooling on a liquid surface, and the penumbræ clouds of condensation, which surround at a certain height the coasts of these islands of slag," offers no exception. It is not new, and has been already overthrown by the investigations of M. FAYE.‡ The other fundamental hypothesis of Professor ZÖLLNER's theory of the physical constitution of the sun, namely, that the masses, which burst out into protuberances, are local collections in bubble-like caverns which form in the superficial layers of a liquid glowing mass, does not derive any support from analogical facts. It must be regarded as a pure hypothesis, unsustained by any inherent probability, or by any known fact, other than that which it is framed to explain. Besides, an hypothesis which brings the hydrogen in eruptive or streaming masses to the sun's surface, does not suffice. Another arbitrary hypothesis is required to dispose of the hydrogen which has thus been accumulating above the sun's photosphere for an indefinite period of time.

Such being the state of the case with regard to the recent attempts to discover the secrets of the sun's physical constitution, in the light of the late remarkable discoveries, we seem to be in this dilemma; whatever conception is formed of the condition of the sun's photosphere—whether liquid or gaseous—it appears to be contradicted by received principles or controverted by established facts. We are thus naturally led to suspect that either some physical cause has been hitherto left out of account, which plays an important part in solar phenomena, or else the conception adopted of the mechanical condition of the solar vapors is radically at fault. It appears to me, that good and sufficient reasons may be urged that will justify both these grounds of suspicion; and that a new point of view may be gained from which we may obtain a deeper insight into the physical processes in operation on the sun.

It is a little remarkable that it should have been hitherto assumed that the facts and laws of terrestrial physics can alone furnish a true philosophical ground for a theory of solar physics; and that no serious attempt should have been made to obtain additional light from known processes in operation on a cosmical scale in the regions of space. There is a class of bodies, some of which, in their periodical excursions through the fields of space, approach quite near the sun, and which are in general conspicuously subject to influences of a powerful nature exerted by the sun, besides the force of gravitation. It certainly seems natural to expect that these cosmical bodies might give us some insight into the nature of the forces in operation at the sun's surface. It is assuredly too late to urge that the transformations which they undergo under the sun's influence are wholly involved in mystery; for it has certainly been satisfactorily established that a portion of the cometary matter becomes subject to a *solar repulsion*, and is urged away by this force with a high velocity, and to great distances from the sun, and that this repulsion augments in intensity as the comet approaches the sun.* Now, if such an energetic force of repulsion emanates from the sun, and operates on cometic matter at all distances, both small and great, according to the law of inverse squares, there is assuredly a high probability that it may play an important part on that vast arena where solar forces are obviously engaged in fierce contention. It may be conjectured that the solar vapors are entirely different substances from, and wholly unlike, in their physical state, the cometary vapors that appear to be so exceedingly subtile. But it is certainly more philosophical to suppose that the same substances—or substances possessed of the same general properties—are present in all cosmical bodies, and the earth. Besides, we are not without direct evidence on this point. HUGGINS, by examining the spectrum furnished by the light emitted from the comet II., 1868, detected the presence of the vapor of carbon in the brighter portions of the comet. "He has been able to discriminate between the light of the nucleus of a comet and that of its tail. The nucleus is self-luminous, and its substance is in the form of ignited gas. The coma shines by reflected light, as clouds do."

If, as is now conceded by astronomers, the tail of a comet is made up of matter detached from the general mass of the comet, by reason of a repulsive action exerted by the sun, it must also be admitted that the matter expelled is not all urged away by the same intensity of force, and with the same velocity; for we find that it is much more widely dispersed in the plane of the cometary orbit than is consistent with this supposition. For example, I have shown, in my theoretical discussion of DONATI's Comet,† that if we conceive particles of matter to have been expelled from this comet, with a certain small lateral velocity, and urged away during a certain interval of time by a solar repulsion bearing to the force of gravitation the ratio of 1·213 to 1, they would, at the end of the interval, have been found distributed over a narrow band coincident, at its forward line, with the curved preceding side of the tail of the comet; and that the other portions of the tail must have been composed of matter subject to various degrees of solar repulsion less than this. In fact, the definite conclusion was in this way reached that the preceding half of the tail consisted of matter repelled from the sun with a force varying between the limits 1·213 and 0, and that the following half was for the most part composed of matter detached from the comet simply by reason of a weakened gravitation toward the sun—the intensity of the force of gravitation along the following side of the tail being 0·455. There would seem, then, to be no alternative but to admit that the tail of DONATI's comet was composed of different substances (or else of one substance in different physical states), subject to a repulsive action from the sun of various degrees of intensity; and either prevailing over the sun's attraction of gravitation, or partially counteracting it, and so giving rise to an effective repulsion for certain of these substances, and to a diminished gravitation for others. The simplest theoretical explanation that can be given of this state of things is to suppose that the *solar repulsion consists of a series of impulses propagated in waves through the ether of space, and taking effect upon atoms of different sizes with varying intensity.* It is obvious that if this be true, the smaller the atom the more effective should be the repulsion as compared with the gravitating force soliciting the atom; since the ratio of the two forces should be proportional to the surface divided by the volume of the atom—assuming that the mass is proportional to the volume, or that all atoms have the same density. We are thus incidentally led to infer that the larger comets consist of a variety of substances, like the earth.

The question now arises, What can be the origin of the force of solar repulsion? There is another side of the diversified picture presented by cometary transformations under the sun's influence, which gives some intimations on this point. Not only is a certain portion of the cometary matter repelled by the sun, but it is also repelled by the nucleus of the comet. We see in large comets a series of envelopes rise at intervals from the nucleus, on the side turned toward the sun, and recede at a nearly uniform rate until they become dissipated by the sun's repulsion. Luminous jets also stream out at times from the same side of the nucleus. These phenomena, it can hardly be doubted, are in some way the effect of the sun's heat. The simplest and most probable conclusion is that the ejecting force which is brought into play by the sun's heat is the direct repulsive energy of the heat received by the comet. We are thus led to infer that *the repulsive action exerted by the sun upon matter in the state of the cometary vapors, probably consists, either wholly or partially, in repulsive impulses propagated in the heat waves proceeding from the sun.*

Let us now see whether any confirmation of these inferences, and any additional light in the direction of our present inquiry, can be obtained on the substantial ground of Terrestrial Physics. The definite question presented for consideration is, whether the results of observation or experiment afford any indication of a direct repulsive action exerted by radiant heat on the atoms of bodies. It is universally admitted that radiant heat, when imbibed by a body, acts as a repulsive or separating agency among its molecules. It is also conceived that the con-

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* Comptes Rendus, vol. lx., pp. 89 and 138.

† Journal of the Franklin Institute, Nov., 1870; also, Philosophic Magazine, Nov., 1870.

‡ Comptes Rendus, vol. lxi., p. 1,089.

* This is generally, if not universally, admitted by astronomers. The author has undertaken, on former occasions, to establish by rigorous calculation that the luminous train of DONATI's comet was developed by a force of solar repulsion co-operating with the attraction of gravitation—both varying according to the laws of the inverse squares.

† Silliman's Journal, II, vol. xxxii., pp. 54–66.

duction of heat is by radiation from atom to atom. The most natural inference from these facts is, that the waves of radiant heat, which pass from atom to atom, directly urge the atoms away from each other by repulsive impulses. Instead, however, of adopting this simple idea, physicists have generally been inclined to refer the expansion of bodies from heat to some mode of motion of the atoms originated by the heat received, though no detailed satisfactory explanation has yet been given of the manner in which such motions would directly originate an expansion. Strangely enough, this notion is even entertained by physicists, who regard heat as the only cause of the repulsion subsisting among molecules of bodies. If should here be noted, that if the expansion of all bodies of matter from heat is to be ascribed to a direct impulsive or repulsive action of heat waves proceeding from one atom and falling upon the surrounding atoms, then this force takes effect at the greatest distances by which the atoms are separated in the rarest gas under the feeblest pressure; and we would thus be led to expect that heated bodies in contact with each other might manifest signs of repulsion. In point of fact, many evidences of a heat repulsion subsisting between particles of different bodies, in contact or in close proximity, have been adduced by different experimentalists and writers on physics, some of which may be briefly mentioned. 1. "When pure silica in an extreme state of division is highly heated, the slightest motion then causes the particles of the powder to slide over each other, and the surface of the powder is thrown into undulations almost like those of a liquid." 2. A rise of temperature is attended with a decrease of capillary attraction. Also the frictional resistance to the flow of water in pipes is diminished by heat. 3. "The spheroidal state of liquids is a complicated result of four different causes. The most influential is the repulsive force which heat exerts between objects which are closely approximated to each other."* 4. The vibrations of heated metals, as shown in "Trevilyan's Instrument," or "rocker," resting on a block of metal, are probably due to the direct repulsive force of heat, as maintained by Professor FORBES, of Edinburgh, in opposition to FARADAY, who conceived that they were attributable to the sudden expansion by heat of the body on which the rocker rests. FARADAY'S explanation of these curious phenomena is adopted by TYNDALL, who endeavors to overthrow Professor FORBES' theory. His experiments serve to disclose the fallacy of certain features of the theory, but do not dislodge the fundamental idea that the phenomena are due to a force of heat-repulsion. This might be made apparent if we had space for a statement of the general principles on which the explanation rests, and for a detailed discussion of the results of the experiments.

Let us now consider if any sufficient evidence exists of a general force of molecular repulsion in operation at all temperatures—beyond the sphere of sensible adhesion, or cohesion. We need, in fact, to look no farther for this than to the simple fact that in the ordinary contact of bodies the interval of distance between them, minute as it is, much exceeds the range of the attraction of cohesion, or adhesion; for in such contact the weight of the upper body is counteracted by a repulsion between the molecules about the point of contact. Dr. ROBISON has shown in his "System of Mechanical Philosophy," that if two glasses, one slightly convex, the other flat, are placed on each other and pressed by a force of 1000 pounds to the square inch, they are still at the distance from each other of the thickness of the top of a soap bubble just before it bursts, or at least 1-4450th of an inch. In effecting this contact there was no evidence of any attraction existing at distances greater than that at which the contact occurred. A similar remark may be made with regard to all cases of the apparent contact of homogeneous substances under a moderate pressure. It is only by increasing the pressure more or less, that the contiguous particles can be brought within the range of their reciprocal attraction of cohesion. When the particles are readily displaced among themselves under the direct action of a pressure, or blow, as in the case of soft or malleable substances, a permanent union may be effected without difficulty between the surfaces; that is, the outer repulsion of some of the particles may be overcome, their attraction of cohesion brought into play at the reduced distance, and an equilibrium established at the neutral point between this attraction and the inner repulsion. This occurs in the welding of iron.

Other evidences of an effective repulsion in operation between the molecules of bodies in contact, or in close proximity, are cited in treatises on physics; although it is not distinctly recognized that the sphere of its action lies entirely without that of the effective molecular attraction. Now, what is the range of this *effective* repulsion between bodies? It obviously extends only to a small distance. CAVENDISH'S well-known experiment has established that, when bodies are separated by considerable distances, they tend toward each other by the attraction of gravitation. But are we therefore to conclude that the repulsive action, so energetic at the near approach of the molecules, has vanished altogether when they are a considerable distance apart? Is it not more probable that this force is confined to the surface molecules, and disappears at moderate distances, in comparison with the attraction of gravitation which is the result of the action of the entire masses on each other, because it decreases according to the inverse squares of the distance between the surfaces instead of the distance between the centres? I have elsewhere shown* that the force of gravitation cannot be the attraction of cohesion operating at considerable or great distances. It is a force *sui generis*, entirely distinct from the forces of the molecular attraction and repulsion in operation at minute distances, and determining the constitution of bodies and their mechanical properties; and operates in conjunction with, but independently of, these molecular forces.†—*The American Journal of Science and Arts.*

* Miller's Physics, p. 285.

† Philosophical Magazine, vol. xxxviii., p. 33.

* In my paper on Molecular Physics, published in Silliman's Journal, vols. xxxviii, xxxix and xl, I have deduced from the fundamental conception of a primitive molecule (or chemical atom) adopted, a force of molecular repulsion operating beyond the sphere of the molecular, or cohesive attraction; and reached the conclusion that this force has its immediate origin in the physical change to which the development of heat is in every instance due, viz.: an inward or contractile vibratory movement of the electric envelopes by which all atoms are conceived to be surrounded, as well as by ethereal atmospheres. It is accordingly termed the molecular heat-repulsion. The repulsive energy of heat in operation on any molecule, is the sum of all the ethereal impulses developed by such movements of the envelopes of other molecules (whether originating in the attraction exerted by the central atoms on their envelopes, or in an external collision or pressure), and propagated to the molecule. From the principle of interception of wave-force it results that the external repulsive action exerted by a solid body is confined to the surface molecules; while a force of heat-repulsion is propagated to an indefinite distance from all the molecules of a gas.

[To be Continued.]

DEPARTMENT OF POPULAR SCIENCE.

Professor Tyndall on "Sound."

RECENTLY, Dr. JOHN TYNDALL, F. R. S., delivered the third of his series of lectures on "Sound," at the Royal Institution Albemarle street, to a large auditory. This lecture was devoted chiefly to the exposition of the laws which govern vibrating musical strings.

Professor TYNDALL, by means of an india-rubber tube hanging from the roof of the theatre down to the lecture table, showed that when a jerk is given to the lower end, the protuberance or wave raised upon the tubes runs along it as a pulse to its fixed end, and, being there reflected, returns to the hand by which the jerk was imparted. The time required for the pulse to travel from the hand to the fixed end of the tube and back, is that required by the whole tube to execute a complete vibration. When a series of pulses are sent in succession along the tube, the direct and the reflected pulses meet, and by their coalescence divide the tube into a series of vibrating parts called ventral segments, which are separated from each other by points of apparent rest, called nodes. The number of ventral segments is directly proportional to the rate of vibration at the free end of the tube. The hand which produces these vibrations may move through less than an inch of space; while by the accumulation of its impulses, the amplitude of its ventral segments may amount to several inches, or even to several feet.

He then by experiment, showed that if a stretched musical string be "damped," or held by the thumb and finger, near one of its ends, and then be made to vibrate by means of a fiddle-bow, it divides itself throughout its whole length into a number of vibrating segments, with points of no motion, or nodes, between each segment. The number of vibrating segments depends upon the rate of vibration at the point encircled by the finger and thumb. Thus, the positions of the points of greatest motion and of no motion in a horizontal stretched vibrating string may be calculated before the vibrations are set up. The lecturer proved this by means of some little Λ-shaped "riders," some colored red, and others blue. He placed the red ones on the calculated parts of no motion, and the blue ones on the points of greatest motion; then when the string was made to vibrate by means of a fiddle-bow, the blue riders were all thrown off, whilst the red ones remained astride the string. The notes corresponding to the division of a string into its aliquot parts, are called the harmonies of the string.

In some further experiments Professor TYNDALL used three tuning forks whose rate of vibration was 64, 128, and 256 times per second respectively. One end of a string was attached to one end of the tuning fork number one, and the other end of the string, after passing over a damper, had a definite weight attached, and when the fork was made to vibrate, the string vibrated also in one great ventral segment. But when the same string, under like conditions, was attached to either of the other forks, it would not vibrate in a single vibrating segment, until the weight, and thereby the tension of the string, was altered. By altering the length of the string, without altering the weight, it could be made to vibrate in one ventral segment with different forks. Any alteration in the thickness of the string also influenced its vibrations.

Professor TYNDALL made these vibrations clearly visible to the whole audience, by darkening the theatre, and illuminating the strings by means of the electric light, so that they threw long shadows on the screen, and when they were made to vibrate, shadowy segments of a gauze-like appearance were seen. In another experiment he showed the segments in an exceedingly beautiful manner. A fine platinum wire, several feet long, was attached to one end of one of the tuning forks, and then made red hot by means of a current of electricity passed through it from a forty-cell GROVE'S battery. When the fork was then made to vibrate, the red hot wire was thrown into vibrating segments, and wherever it vibrated most it was of course most cooled by the air, so there became dark—lost all its redness. But at the nodal points it remained red hot. Thus by its own vibrations it was divided into red hot and and dark sections. While thus vibrating, the red hot nodal points were hotter than while the whole string was at rest, because the cooling of the other portions of the wire increased their electrical conductivity, and thus a more powerful current acted on the points of no motion.

By experiments like these, Professor TYNDALL proved that the following four laws governed the vibration of strings: The rate of vibration is inversely proportional to the length; it is inversely proportional to the diameter; it is directly proportional to the square root of the stretching weight or tension; and it is inversely proportional to the square root of the density of the string. When strings of different diameters and densities are compared, the law is, that the rate of vibration is inversely proportional to the square root of the diameter of the string. The amount of motion communicated by a vibrating string to the air is too small to be perceived as sound, even at a small distance from the string. Hence, when strings are employed as sources of musical sounds, they must be associated with surfaces which take up their vibrations, and transfer them to the surrounding air. Thus the tone of a harp, a piano, a guitar, or a violin, depends mainly upon the sound-board of the instrument. A tuning-fork held in the hand makes very little noise when struck, but if the end of it be then placed upon a table or sounding-board, the large surface of wood takes up the vibrations, consequently the surrounding air is thrown into loud musical waves. When any two forks or strings placed near each other have a tendency to vibrate at the same rate, the one which is motionless tends to take up vibrations from the other when the latter is made to sound, the vibrations being conveyed by the air or by the sounding-board. Professor TYNDALL fixed one tuning-fork on the top of a box, then he struck another which he held in his hand, immediately after which he held the vibrating fork within a quarter of an inch of the motionless fork on the box. The latter fork then began to sound, since it took up the motion of the other one from the waves of air; the noise made by the first fork could not be heard by the persons present, because it was held in the hand, and had no sounding-board. These two forks had the same rate of vibration, otherwise the experiment could not have been performed. If two pendulums, which vibrate at the same rate, be hung upon the same wall, and one of them, with the clock belonging to it, be set in motion, the other pendulum will often begin to swing after the lapse of a little time, because of the accumulation of small impulses following each other in regular succession.

The lecturer said that when a string vibrates as a whole, it usually divides at the same time into its aliquot parts. Smaller vibrations are superposed upon the larger, the tones corresponding to the smaller vibrations, which are known as overtones, mingling at the same time with the fundamental note of the string. It is the addition of such overtones in different proportions to fundamental tones of the same pitch, which enables the listener to distinguish the sound of a clarionet from that of a flute, and the sound of a violin from both. Could the pure fundamental tones of these instruments be detached, they would be undistinguishable from each other; but the different admixture of overtones in the different instruments renders their *timbres* diverse, and therefore distinguishable. When a stretched string is plucked aside, or agitated by a bow, all the overtones which require the point agitated for a node vanish from the clang of the string. The point struck by the hammer of a piano is from one-seventh to one-ninth of the length of the string from its end; by striking this point, the notes which require it as a node cannot be produced, a source of dissonance being thus avoided.

At the close of this lecture, Professor TYNDALL took a small vertical glass tube, about eighteen inches long, open at both ends, and fixed it in a stand. Then he inserted a small gas flame in it, so that, as usual under such conditions, the flame began to make a singing noise, which noise the lecturer stopped by placing his finger for an instant on the mouth of the tube. Then he asked his assistant, Mr. COTTRELL, to sing to the flame, which he did in a most melodious manner, the note being much like that made by a screech owl, but when the sound of the voice reached the same pitch as that at which the flame had a tendency to vibrate, the flame instantly began to sing, but it would not sing in response to sounds of any other pitch. The principle on which the one vibrating body thus took up motions from another, was, of course, the same as that already mentioned, wherein two pendulums or two tuning-forks were each made to sing by the other.—*Mechanics' Magazine.*

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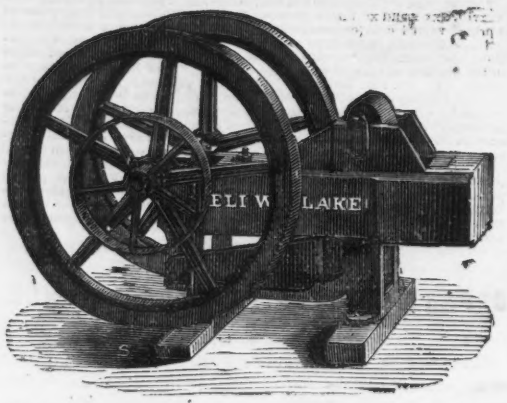

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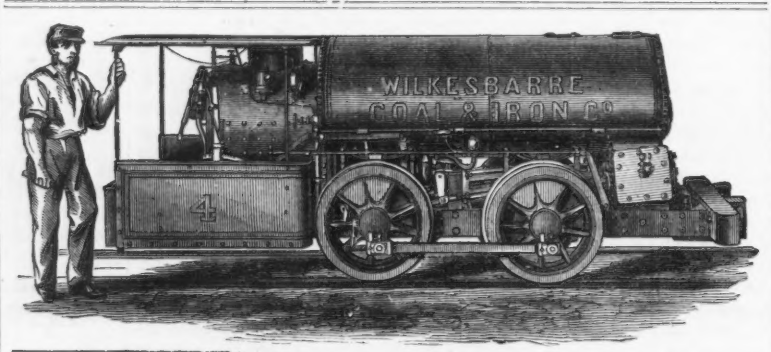

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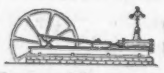
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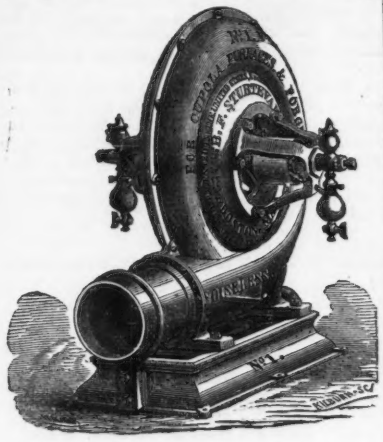

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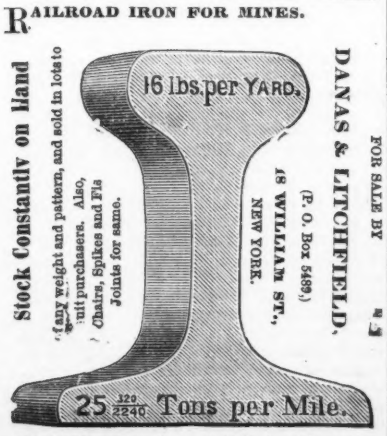
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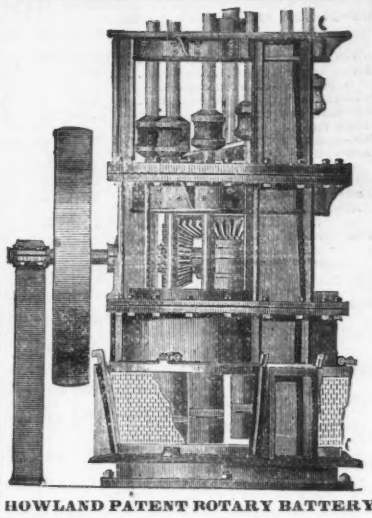

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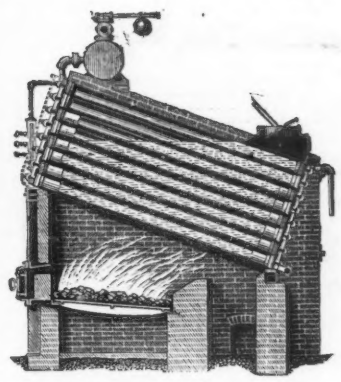

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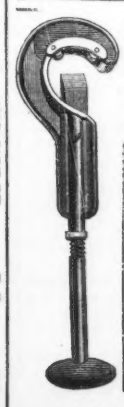

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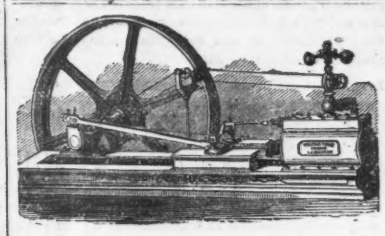

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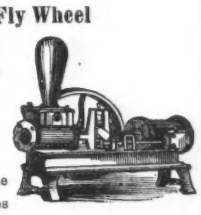

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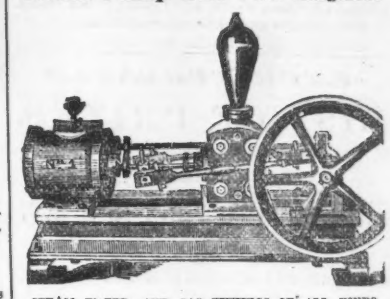

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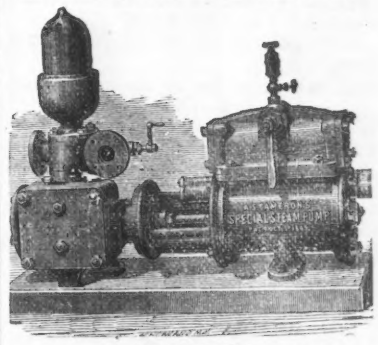

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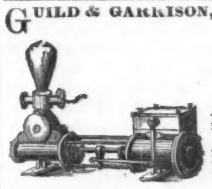

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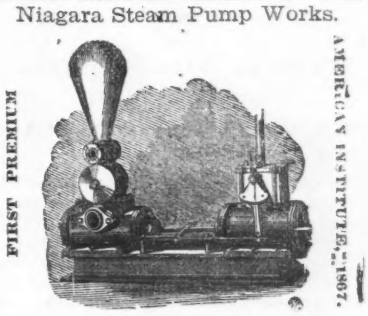

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113	Revolver, Smith & Wesson's, No. 2	15 00	22	75
	FROM MASON & HAMLIN.			
114	Melodeon, portable, No. 1, 4 octave	50 00	66	200
115	Melodeon, resonant, style G, 5 octave	170 00	146	510
116	Pipe-Organ, church use, style No. 29	675 00	579	2000
	FROM J. S. & C. ODELL.			
117	Pipe-Organ	500 00	430	1500
118	Pipe-Organ	700 00	600	2100
119	Bradbury Square Piano-Forte, No. 4	650 00	430	1500
120	Steinway's No. 1 Grand Piano	1200 00	860	3000
	THE AMERICAN WATCH CO., WALTHAM, MASS.			
121	Silver Watch	20 00	32	100
122	Silver Watch	35 50	48	142
123	Gold Watch	50 00	65	200
124	Lady's Gold Watch	100 00	110	350
	FROM THE UNITED STATES WATCH CO.			
125	Silver Watch	40 00	50	150
126	Silver Watch	66 00	75	275
127	Gold Watch	100 00	100	300
128	Silver Watch	104 00	104	312
129	A Sewing Machine (your choice)	65 00	65	200
	FROM MCALLISTER.			
130	Microscope and 48 objects	10 00	14	40
	FROM COLBY BROS. & CO.			
131	Velocipede for Boys	16 00	16	52
	FROM MCALLISTER.			
132	Magic-Lantern, No. 433	20 00	30	95
	FROM H. THOMPSON.			
133	An Easy Chair			
	FROM D. APPLETON & CO.			
134	New American Cyclopædia, 16 Vols.	80 00	80	213
	FROM G. & C. MERRIAM.			
135	Webster's Unabridged Pictorial Dictionary	12 00	15	45
136	Webster's National Pictorial Dictionary	6 00	10	35
	FROM WESTERN & COMPANY.			
137	One back vol. Manufacturer and Builder, unbound, post-paid	1 75	6	25
138	Two back volumes Manufacturer and Builder, unbound, post-paid	3 50	11	37
139	One back vol. Manufacturer and Builder, bound, post-paid	2 50	9	32
140	Two back volumes Manufacturer and Builder, bound, post-paid	5 00	18	58
141	Cover for binding the Manufacturer and Builder, post-paid	60	3	21
142	A $10 Library (your choice from list in special sheet),	10 00	18	58
143	A $15 Library,	15 00	24	85
144	A $20 Library,	20 00	31	106
145	A $25 Library,	25 00	38	125
146	A $30 Library,	30 00	44	144
147	A $35 Library,	35 00	50	162
148	A $40 Library,	40 00	56	177
149	A $45 Library,	45 00	62	192
150	A $50 Library,	50 00	68	207
151	A $60 Library,	60 00	80	237
152	A $75 Library,	75 00	100	282
153	A $100 Library,	100 00	125	360
154	A choice of good Books (see terms in another column)			
155	A choice of convenient Book-Cases (see special sheet)			
156	A choice of popular Music (see terms in special sheet)			
157	A choice of Games and Toys, (see terms in special sheet)			

All paid through by mail or express.

We have taken especial pains to select in making up our price list the NEWEST and very BEST articles. No charge will be made for boxing or packing any article on our list. The Premiums, Nos. **4** to **7** inclusive, **31** to **35** inclusive, **74 99, 101, 105** to **108** inclusive, **121** to **128** inclusive, **137** to **141** inclusive, **154, 156, 157,** will each be delivered FREE of charge by mail or express (at the Post-office or express office nearest recipient) to any place in the United States or Territories. The other articles cost the recipient only the freight after leaving the manufactory of each, by any conveyance specified.

As an aid to those who engage upon large clubs, we will count subscriptions by *one* individual for 1869, 1870, and 1871, as *three* subscribers toward a premium. Every *new* subscriber should have the work from the beginning. Bound volumes may be counted in the same way—each as one subscriber—except, of course, when they are obtained as a premium.

Do not fail to note the following Points:

1. All subscribers sent by one person count, though from one or a dozen different post-offices. But

2. State with each name or list of names sent that it is for a premium.

3. Send the names as fast as obtained, that the subscribers may begin to receive the paper at once. You can have any time, from one to six months, to fill up your list.

4. Send the exact money with each list of names, so that there may be no confusion of money accounts.

5. Old and new subscribers all count in premium clubs, but a portion, at least, should be new names; it is partly to get these that we offer premiums to canvassers.

6. Specimen numbers, cards, and show-bills will be supplied free, as needed by canvassers; but they should be used carefully and economically, as they are very costly.

7. Remit money in Checks on New York banks or bankers, payable to order of WESTERN & COMPANY, or send Post-Office Money Orders. If neither of these is obtainable, Register Money Letters, affixing stamps both for the postage and registry; put in the money and seal the letter in the presence of the postmasier, and take his receipt for it. Money sent in any of the above ways is at our risk.

DESCRIPTIVE LIST OF PREMIUMS.

Every Premium in the annexed list is described in the December MANUFACTURER AND BUILDER, *and also in a* **Special Descriptive Sheet,** *which will be sent* **free** *to every one desiring it. We have room here for the following only:*

No. 1—Chest of Good Tools.—We are able, through the special favor of Messrs. Patterson Brothers, of 27 Park Row, to offer chests of the very finest quality of tools, of kinds and prices named below. Similar tools could be purchased for half the money; but these are all A No. 1, for practical use, and worth a dozen common articles. For this we have the guarantee of Messrs. Patterson, which is amply sufficient for us, and for all who know them. Any of these tools may be ordered of them. We make up only a single premium, which contains a full assortment for all common purposes. The tools are of regular size, and but few additions would be required for a journeyman carpenter. The assortment we offer is as follows: 1 tool-chest, $8; 1 jack-plane, $1 75; 1 smooth-plane, $1 50; 1 fore-plane, $2 25; 1 handsaw, 22 in., $1 75; 1 compass saw, 10 in., 50c.; compass, 6 in., 37c.; 1 adze-eye hammer, No. 4, $1 25; 1 hatchet, No. 2, 90c.; 1 draw-knife, 7 in., $1 12; 1 try-square, 6 in., 70c.; 1 bevel, 8 in., 75c.; 1 chalk-line and spool, 30c.; 1 mallet, 30c.; 1 pair of pliers, (steel,) 5 in., 60c.; 1 pair of calipers, 4 in., 36c.; 1 brace, No. 2, $2 25; 1 auger-bit, ea., ¼ in., 30c.; ½ in., 32c.; ¾ in., 45c.; 1 in., 60c.; 1 centre-bit, ea., ½ in., 21c.; ¾ in., 23c.; 1 in., 25c.; 1¼ in., 35c.; 1½ in., 40c.; 6 gimlet-bits, assorted, 90c.; 3 gimlet-bits, assorted, 33c.; 1 screw-driver bit, 25c.; 1 flat countersink, 25c.; rose, do., 25c.; snail, do., 25c.; 1 octagon reamer, 30c.; 1 taper-bit, 30c.; 1 screw-driver in handle, ea., 3 in., 30c.; 6 in., 50c.; 1 gouge in handle, ea., ¼ in., 50c.; 1 in., 70c.; 1 chisel in handle, ea., ¼ in., 30c.; ½ in., 35c.; ¾ in., 40c.; 1 in., 50c.; 1¼ in., 60c.; 1 framing-chisel, ea., ¾ in., $1; 1 in., $1 10; 1¼ in., $1 20; 1 auger, ea., ¾ in., 70c.; 1 in., 80c.; 1¼ in., 90c.; 1 set bradawls in handles, $1 35; 1 rule, 2 feet, 25c.; 1 saw file, ea., 4 in., 14c.; 5 in., 17c.; 1 flat bastard file, 8 in., 30c.; 1 wood-rasp, 50c.; 1 soldering copper, 60c.; solder nails, etc., $1 25;—**$45 00.**

Nos. 2, 3—Mathematical Instruments for Draughting, Drawing, Etc.—Very convenient not only for architects and mechanics, but for boys and girls. These are neatly fitted in beautiful rose-wood cases, having dividers with flexible joints, and points, semi-circles, pencil and penholders, rulers, etc., etc. All the pieces in No. 2 are finished in brass and steel; those in No. 3 are German-silver and steel. The pieces are the same in each, but No. 3 is of extra beauty and workmanship. 18 subscribers at $1 50 each secures No. 2, and 22 at $1 50 each, No. 3.

Nos. 4, 5, 6, 7—Pocket Knives.—Here's for the boys and girls. These premiums are among the most pleasing and useful that we have ever offered. Every boy, and girl too, wants a pocket knife. We give them an opportunity to obtain a most valuable one for merely a little effort. These knives are from Messrs. Patterson Bros. No. 4 is a neat, substantial knife, with three blades and buck-horn handle. No. 5 is a still finer article, with four blades and buck-horn handle. No. 6 is an elegant knife, with four blades and shell handle. No. 7 is a lady's pocket-knife, a beautiful article, with four blades and shell handle.

Nos. 8, 9, 10, 11, 12, 13—American Table Cutlery.—We are glad to be able to offer really good articles of American manufacture, such as are competing successfully with the best foreign goods. ***Messrs. Patterson Bros., 27 Park Row,*** who supply us with these articles, are also importers of English goods. They recommend these knives, manufactured by the ***Meriden Cutlery Co.,*** as equal to any cutlery in the market, and their recommendation is a guarantee wherever they are known. We offer four kinds of knives, and three sizes of each kind. No. 8 have rubber handles, which are actually boiling-water-proof, so that, if they were accidentally to remain in it for several minutes, or even hours, they would not be injured. The blades are of the best steel, and warranted Dessert size, with forks, sold at $14. For 23 subscribers at $1 50, or 78 at $1, we will give either the medium size or the table size, sold at $15 50. No. 9 have ivory handles, are selected with great care, have steel blades, and are beautiful goods. Dessert size, with forks, sold at $18 50. For 31 subscribers, at $1 50, or 100 at $1, we will send the medium size, sold at $20 50. For 34 at $1 50, or 112 at $1, we will send the table size, sold at $22 50. No. 10 are made of solid steel, and are triple plated all over with pure silver, which will wear for a long time, while the knife is actually indestructible by ordinary use. Dessert size, with forks, sold at $22. For 37 subscribers, at $1 50, or 118 at $1, we will give the medium size, sold at $24 50. For 38 at $1 50, or 120 at $1, we will send the table size, sold at $25. For 38 at $1 50, or 120 at $1, we will send the table size, sold at $25, No. 11 have steel blades, triple-plated with silver, and larger ivory handles, and are really splendid goods. Dessert size, with forks, sold at $25 50. For 42 subscribers, at $1 50, or 128 at $1, we will give the medium size, sold at $28. For 45 subscribers at $1 50, or 143 at $1, we will give the table size sold at $30 50. The forks, which accompany these premiums, Nos. 8, 9, 10, are made of genuine albata, and warranted double-plated with coin-silver. The forks with No. 11 are warranted triple-plated with coin-silver. These forks are also furnished to us by Messrs. Patterson Bros. The carving-knife and fork, and fluted steel, are made by

the Meriden Cutlery Co., with the best ivory balanced handles.

Nos. 14 to 29—Silverware for the Table.—What would become of elegance and refinement in the furnishing of homes if the ladies (God bless them!) had not such an amiable passion for endlessly beautifying everything around them? Ever since Eve first set out the fruit of Paradise on its broad leaves to entertain the angel guests of Adam, it has been the province of her lovely daughters to spread the social board with attractions still more tempting to the eye than to the palate. What, that becomes a woman, will not a woman do to make her table shine? We condole with them that their means are not always equal to their good taste, and propose that henceforth no lady shall lack a lustrous silver tea-set, or other piece of similar elegance, unless she chooses to. Look at the following premiums, all of the celebrated manufacture of Messrs. HALL, ELTON, & Co., 36 Park Row, New York; No. 28 is silver-plated, gold-lined, beautifully chased **Tea Set** of six pieces, consisting of a coffee-pot, two tea-pots, a creamer, a sugar-bowl, and a slop-bowl. The style of this set is very neat, new and elegant. Messrs. Hall, Elton & Co, warrant these goods to be their best triple plate. This is a very desirable premium. No. 29 is a tea-set with same number of pieces, triple-plated, plain, new style.

Nos. 31, 32, 33, 34, 35—GOLD PENS, Rubber Mounted with Ever-Pointed Pencils—Pens in Gold and Silver Holders—Pens and Pencils in Extension Cases.—No. 31 has a gold-mounted rubber case, with pencil, and a No. 4 gold pen, manufactured by MABIE, TODD & Co., 180 Broadway, New York. This and the next, No. 32, are, we think, really the best things of the kind manufactured. The fact that hard rubber is used, shows that the gold for the mountings, etc., is of the finest quality, as rubber, on account of the sulphur contained in it, can not be mounted with any other without tarnishing. When closed, the pencil No. 31 is only 5 inches long, (No. 32, 3¼ inches,) but it opens to a length of 5¾ inches. The price for the holder and pencil of No. 31 is $6, pen $2; and of No. 32, or smaller size, $5 for the case, and $1 75 for the pen. Fifteen subscribers will give you the former, or gentleman's size, and 13 the latter, or lady's size. No. 33 is a No. 6 gold pen, with silver or gold-plated holder with an ebony handle—a very neat, desirable business-pen. By describing the kind of pen you prefer, we can probably select one that will suit your hand perfectly. We send these by mail, in a neat turkey morocco box, lined with velvet, in which they can be kept, protected from injury. No. 34 is a large pen, in a fine extension case, round or fluted, and richly engraved. The gold is 14 carats fine. These pens, which are nicely put up in boxes, are a very beautiful thing for a present. Price $20, and sent, postage paid, to any address, upon receipt of 29 subscribers at $1 50 each. No. 35 is a lady's gold pen, with ivory holder. Price, $2 75. This is indeed a very neat and beautiful pen for ladies' use. We send it, postpaid, by mail, inclosed in a handsome velvet-lined morocco box, for 6 subscribers.

No. 38—The Celebrated St. Germain or German Student's Lamp.—as it is sometimes called. This lamp is made and furnished to us by C. F. A. HENRICHS. It scarcely needs eulogium, being the standard thing in our leading colleges, both among students and professors. They reject gas, even where it is most plentiful and convenient, and save their much-worked eyes by the motionless pure white light for which this lamp is so remarkable. No other artificial illumination approaches so nearly to the still colorless sunlight. The secret is in the scientific adaptation of burner and chimney to produce that perfection of draught by which absolute combustion is attained without vibration. The porcelain shade softens the light most agreeably. The lamp slides on a vertical standard, and is adjusted by a set-screw at any desirable elevation to accommodate the work or the eyes. The reservoir is elevated above and at a short distance from the burner, (communicating by a pipe,) so that the oil is always cool and out of reach of flame. The reservoir can be taken out of its telescopic socket, and carried away to another room and filled and returned, without putting out the light. The lamp will be a treasure worth no little trouble to obtain to any one who needs strong light, or who values eye-sight, economy, neatness, pure air, and freedom from trouble and annoyance with lamps; as in all these points it is without a peer. The price of these lamps is $8, with 25 cents for packing. The mineral sperm oil can be had from most respectable dealers, or ordered in packages of any size (1 gallon upward) from Messrs. HENRY RUSSELL & Co., 38 Park Place, New-York.

No. 39—Family Scales.—These scales combining the advantages of counter and platform scales, are peculiarly adapted to household purposes. They weigh from ½ ounce to 240 lbs. They have a scoop or pan for weighing flour, sugar, and other house stores, and a platform for heavier articles, and are just such an apparatus as is needed for in-door or out-door use, occupying less than two feet square. These scales are manufactured by the well-known FAIRBANKS & Co., No. 252 Broadway New York, whose weighing apparatus has long ranked as the standard in all parts of the country. Send to them for circulars, if desired.

Nos. 45-53—Bailey's Patent Planes.—To those who have used these planes and know their value, is but small praise to say that they are superior to any others made. They are so far ahead of any others that there can be no comparison between them. They are self-adjusting in every respect. Both the wood and iron planes are entirely independent in themselves, requiring neither hammer, screw-driver, nor wrench to replace or adjust the cutter, which is held firmly in place and can be instantly released by use of the cam and its thumb-piece. The cutter is adjusted by simply turning a thumb-screw under the bed-piece upon which the plane-iron rests. By this the cutter can be adjusted to any thickness of shaving. The Stanley Rule and Level Co., 55 Chambers Street, New York, warrant these planes to be of the best stock and finish. The various numbers and sizes of these planes which we offer gives carpenters, mechanics, and others desiring them, an opportunity to get a complete set of either the wood or iron planes as premiums. The smooth planes, of which we offer two sizes, are 5½ inches long, 1¾ inch cutter; and 8 inches long, 1¾ inch cutter.

Jack plane..	.....14 in. long,	2	in. cutter.	Iron.
Fore "	.....18 " "	2⅜	" "	
Jointer "	.....22 " "	2⅜	" "	

In the wood planes the lengths and widths of cutter embrace all sizes made. Forty-four subscribers at $ .50 each, or 141 subscribers at $1 each, will get a complete set of the wood-planes. Sixty-nine subscribers at $1.50 will get a complete set of the iron planes, which will last a life-time. If larger sizes than those given are wanted, a few extra subscriptions will be required, according to the difference in the price.

Nos. 54-76—Machinists' Tools.—This series of premiums, consisting of machinists' tools, etc., has been selected and put up at the suggestion of several practical men with whom we have consulted in regard to the subject. These gentlemen, who have a practical knowledge of the tools, and of the requirements of all who have any thing to do with the working of metals, give their unqualified approval of the tools we have selected. This list of premiums has been made so extensive that every man who has any industrial operrtions to carry on will find some tool or tools absolutely necessary to him. By sending us clubs of subscribers to THE MANUFACTURER AND BUILDER these tools may be obtained by the smallest possible amount of labor. Of the qualities of these tools, in point of finish, we know them to be the best in the market—the best, without challenge. When a man has a set of any of them in his tool-chest, he knows he has the means of producing work equal to any that can be done. We obtain these tools from the general agents, Messrs. POST & GODDARD, 109 Liberty Street, New York.

No. 77—Foot-Lathe No. 1.—Of these useful articles we offer two kinds. No. 1 is perfectly adapted for most kinds of turning in wood or metals; also drilling, boring, polishing, sawing, etc. It seems to be the size desired by most people. This is proved by the great numbers of them sold. This lathe takes a piece between centres 19 inches long and 6¼ inches wide in diameter. It weighs 200 pounds. It is fitted with two pointed centres, one spur-centre, face-plate turned and polished, twe rests, one 9 and the other three inches long; also centre key and wrench combined, which fits the screw heads in different parts of the lathe. The balance-wheel weighs 45 pounds, is turned true, and is polished. It has two sizes for change of speed. This size of lathe has a great many extra parts made for it, so that whenever they are wanted they can be obtained. This is a very valuable point, as in buying other machines of the kinds only such things as happen to fit can be used, and they are not always to be found when wanted. The Rev. JOHN TODD, D.D., speaking of lathes, says in regard to these, "For price, for finish, for beauty and workmansip, I have never seen any American lathe so desirable. Of the No. 1 he says: "Nobody can own the lathe without daily gratitude." We procure these lathes through Mr. LUCIUS W. POND, 98 Liberty street, the well-known manufacturer of machinists' tools. Few people can obtain one of these lathes more easily than by obtaining 65 subscribers for THE MANUFACTURER AND BUILDER, for which we ship this premium, without any additional charge for boxing. The regular price is $50. We include leather belt 8 feet long, which costs 90 cents in the price given in the table.

No. 78—Foot Lathe, No. 2.—Our subscribers are frequently asking for second-hand lathes, saying at the same time that such a one would answer their purpose, and probably come cheaper. There are many others who do not care for so complete a lathe as No. 1. The No. 2, we think, will answer this demand. It is made of cheaper materials, but in the same style as lathe No. 1. The frame is of wood, with curved legs, which give it a neat and attractive appearance. It is painted and ornamented in the best style. The bed is made with iron slides three feet long. Will take a piece between centres 21 inchhes long and 6¼ inches in diameter. It has an iron pulley like No. 1. The spindle runs accurately. The face-plate takes off, and the centres are fitted to tapering sockets. Tailstock spindle traverses with a left-hand screw. Everything is well fitted and finished. The balance-whee is the same pattern as for lathe No. 1, and is turned true. The lathe, with face-plate, long and short T rests, two pointed centres, spur-centre, and wrench, packed for transportation, costs $30. For this we also include the leather belt, 8 feet long, which is used on the driving wheel. We box this lathe and deliver it on the cars for a club of 47 subscribers at $1 50 each, or 124 at $1. The twist-drills and chucks—premiums 65, 66, and 69 to 73—especially the smaller sizes, are just the things for these lathes. The chucks, No. Ox, 2 and 3, cost $2 extra for fitting in the lathe. Those desiring further information in regard to the premium may send to WESTERN & Co., 37 Park Row, New York, for an illustrated pamphlet.

No. 79—The Dollar Steam-Engine.—This is a real working steam-engine and boiler, which runs half an hour, or until its fill of water is evaporated, by means of a small spirit-lamp, which forms a part of it. It can not explode or get out of order. A most instructive as well as entertaining toy. Sent, prepaid, for 5 subscribers at $1 50. It is manufactured by COLBY BROTHERS & Co.

Nos. 80, 81, 82, 83—Compact and Powerful Portable Steam-Engine and Boiler.—BAXTER'S patent is acknowledged by many experienced engineers to be the most perfect combination, of standard principles exclusively, and thorough workmanship, ever made in a portable engine. At the same time such is its compactness and the scale and system on which it is manufactured, (by the Colt Armory, at Hartford, Ct.,) that it is afforded at the lowest price ever known for the same (actual) power. It is made by machine tools constructed expressely for it, of standard interchangeable parts throughout, like the celebrated American watches. Consequently we are able to make it one of our most attractive and valuable premiums. Besides, it is warranted to consume less fuel per horse-power than any other engine. This is in consequence, partly, of the improved arrangement of the boiler and the cylinder being entirely let into the steam-space, to save room and heat. The one-horse engine and boiler (which, like the others, will run above, not below rated power) stands but five feet high, over all, by two feet in diameter. This is premium No. 80, costs $300, and can be had for 320 subscribers at $1 50 each, or 1125 at $1 each. The five-horse engine and boiler stands 6¼ feet high by 3 feet in diameter, costs $800, and can be had for 858 subscribers at $1 50 each. The ten-horse engine costs $1200, and will run a good sized manufactory. There is now no reason why any body should be without a first-class steam-engine, especially as these engines are so simple, snug, safe, and economical of fuel that they can be run in any apartment by the fire required to warm it, and by and person of common intelligence, and will be received from the factory in perfect readiness for use. For running small lathes, drills, etc., circular and scroll saws, printing-presses, corn-huskers, cider-mills, fanning-mills, feed-mills, cotton-gins and hullers, cheese-presses, churns, pumps, washing-machines, sewing-machines, rotary blowers for forges and other purposes, etc., the smallest of these engines will be found thoroughly effective, and as little incnmbrance and trouble as a kitchen stove. For business, however, we recommend to try for one of ample rather than of bare sufficiency.

Nos. 84, 85, and 86—Steam-Pumps.—These steam-pumps are of the best class and quality, economical in the use of steam, and capable of being applied in various ways. No. 84 is one of Hardick's manufacture, which took the first prize at the Fair of the American Institute a year ago. Nos. 85 and 86 are two sizes of the celebrated Cameron pump. Nos. 1 and 2. The first has a steam cylinder 4½ by 7 inches, and its capacity of ordinary speed is 15 gallons per minute, and costs $150. Size No. 2 has a steam cylinder 6 inches in diameter, with 8-inch stroke. It costs $200, and is capable at ordinary speed of delivering 30 gallons of water per minute. These pumps are remarkable for their compactness, simplicity, and durability. The valves are large and not liable to become choked up. By simply removing the bonnet, access can be had to them for inspection or repair,

Nos. 105 to 108—To Procure a Patent without Money.—We have met with many having valuable inventions, which inventors are anxious to get patented, but are unable to afford the expense, and consequently fail to secure the profits which a patent might produce. To such as are in this position, we make the following liberal offer: No. 108—We will prepare an application for a patent, attend to its passage through the Patent Office, and pay all government fees and incidental expenses attending the same, for any inventor presenting a patentable invention, who will get up a club of seventy-five subscribers for THE MANUFACTURER AND BUILDER for one year at $1,50 each, or 250 at $1 each, and send us the money by post-office order. If this application should be rejected, they may send us an additional list of thirty subscribers at $1.50 each, and the subscription money for the same, on receipt of which we will prepare and prosecute a second application, paying all government fees and incidental expenses. No. 107—For a list of fifty subscribers at $1.50 each, or 150 at $1 each, with the cash accompanying it, we will prepare an application, attend to its passage through the office, and pay the government fee ($15), the applicant paying the second government fee of $20. No. 106—For a list of thirty-five subscribers at $1.50, sent in the same way, we will prepare and prosecute an application, the applicant paying the government fee. No. 105—for twenty-eight subscribers at $1.50 each, or eighty at $1 each, we will prepare and file a caveat, furnish the necessary drawings, (which we also furnish in all the above cases), and pay all government fees. All cases placed in our hands under these arrangements will receive our best attention, equally with those for which our fees have been paid in cash, and will be appealed to the Board of Examiners-in-Chief, if necessary, the applicant paying the government fee of $10 on such appeal. If the inventor has no model to accompany his application, he may procure additional subscribers, the premium on which (see cash rates) will enable him to pay for the model. A club of 100 names has been obtained in a single establishment where from 150 to 200 hands are employed. A village of 500 inhabitants will take this number readily.

No. 129—Sewing Machines.—Your choice! A $65 machine for 65 subscribers, at $1.50 each.—It makes no difference to us which machine we send, or whether it is selected at first or at the last moment. No charge for boxing the machines; they go safely as freight. For circulars, giving full particulars in regard to style of machines, fixtures, etc., as well as instructions, send to **Grover & Baker Manufacturing Co.**, 495 Broadway, New York; **Florence Sewing Machine Co.**, 505 Broadway, New York; **Wilcox & Gibbs Sewing Machine Co.**, 658 Broadway, New York; **Singer Sewing Machine Co.**, 458 Broadway, New York.

Nos. 137, 138—Volumes of the Manufacturer and Builder.—The unbound volumes of THE MANUFACTURER AND BUILDER consist of a set of number for a year, each separate in its own paper cover. These volumes amount to a valuable Library on all matters pertaining to the Industrial Arts, and contain more varied information on manufacturing, building, and mechanical subjects than can be obtained in books costing three times as much. The price of the volumes unbound is $1.50 each, at the office, or $1.75 if sent by mail, as they must be post-paid. They are profusely illustrated, the engravings used in them having alone cost thousands of dollars. For ordinary use, the sets of numbers unbound will answer quite well.

Nos. 139, 140—Bound Volumes of the Manufacturer and Builder.—*New* subscribers almost invariably desire to secure the back numbers of THE MANUFACTURER AND BUILDER from its commencement. Some desire them bound in our uniform style, while others prefer to get the loose numbers and have them bound to suit their own tastes. *Our* binding is very neat, and being done in large quantities at one time, is furnished at a *very cheap* rate. It is moreover very handsome, being of cloth, with gilt title and back, sides embossed and ornamented with a neat architectural device stamped in gold. The price of the volumes is $2.50 each, sent post-paid.

No. 141—Covers for Binding the Manufacturer and Builder.—These are described in premium 139, 140. Now ready for 1869 and 1870. Be careful to state *which year* you require. Any country binder will insert the year's numbers in one of these covers at a moderate cost. Price, 50 cents; sent, *post-paid*, on receipt of three subscribers at $1,50 for each cover.

Nos. 143 to 154—Good Libraries.—In these premiums we offer a choice of books for manufacturers, mechanics, artisans, builders and others. The person entitled to any one of the premiums 142 to 153, may select any books desired from the list published in our Special Premium Sheet, to the amount of the premiums, and the books will be forwarded, post or express paid. $25 or $50 worth of books pertaining to the industrial arts will give the boys new ideas, set them to thinking and observing, and thus enable them to make their heads help their hands. Any good book will, in the end, be of far more value to a youth than to have an extra hundred dollars on coming to manhood. ☞ Let the mechanics of a neighborhood unite their efforts, and through these premiums get an industrial library for general use.

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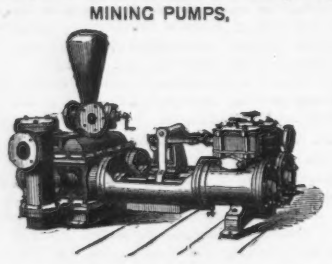

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U. S. PATENT OFFICE,
WASHINGTON, D. C., May 26, 1871.

On the petition of THOMAS J. CHUBB of New York N. Y., praying for the extension of a patent granted to him on the 25th day of August, 1857, for an improvement in Separating Ore.

It is ordered that the testimony in the case be closed on the 25th day of July next, that the time for filing arguments and the Examiner's report be limited to the 4th day of August next, and that said petition be heard on the 9th day of August next. Any person may oppose this extention. M. D. LEGGETT, Commissioner.

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U. S. PATENT OFFICE,
WASHINGTON, D. C., May, 25, 1871.

On the petition of CHARLES H. SAYRE of Utica, New York, praying for the extension of a patent granted to him on the 25th day of August, 1857, for an improvement in Cultivators.

It is ordered that the testimony in the case be closed on the 25th day of July next, that the time for filing arguments and the Examiner's report be limited to the 4th day of August next, and that said petition be heard on the 9th day of August next. Any person may oppose his extension. M. D. LEGGETT, Commissioner.

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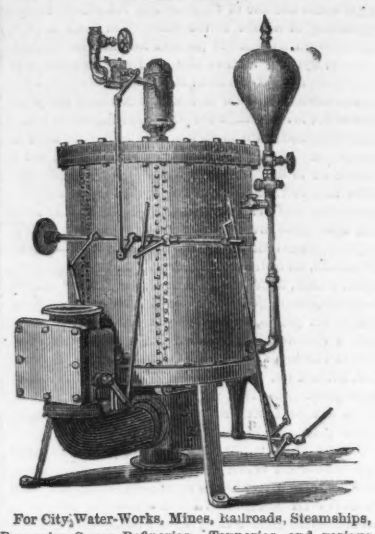

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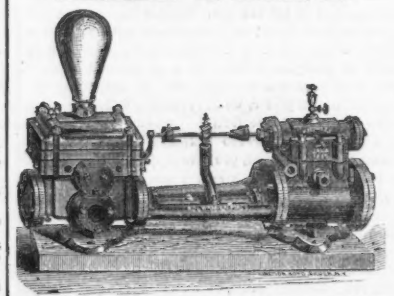

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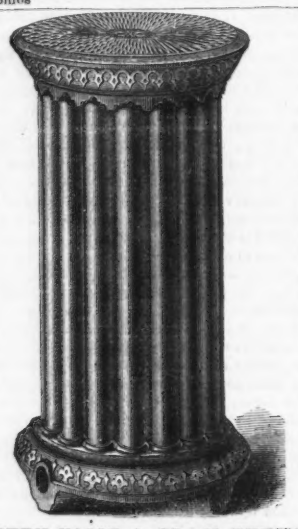

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U. S. PATENT OFFICE,
WASHINGTON, D. C., May 11, 1871.

On the petition of JOHN TOULMIN of Worcester, Mass., praying for the extension of a patent granted to him on the 25th day of August, 1857, for an improvement in Vibrating Shears.

It is ordered that the testimony in the case be closed on the 25th day of July next, that the time for filing arguments and the Examiner's report be limited to the 4th day of August next, and that said petition be heard on the 9th day of August next. Any person may oppose this extension. M. D. LEGGETT, Commissioner.

U. S. PATENT OFFICE,
WASHINGTON, D. C., May 11, 1871.

On the petition of JOSEPH W. BUDD of Midland City, Michigan, Administrator of ISRAEL DODENHOFF, deceased, praying for the extension of a patent granted to the said ISRAEL DODENHOFF, on the 18th day of August, 1857, for an improvement in Raking Apparatus for Harvesters.

It is ordered that the testimony in the case be closed on the 18th day of July next, that the time for filing arguments and the Examiner's report be limited to the 28th day of July next, and that said petition be heard on the 2d day of August next. Any person may oppose this extension. M. D. LEGGETT, Commissioner,